10.1.2 Current Traffic Conditions

(1) Vehicular Traffic Flow Condition

1) Vehicular Traffic Volume in the Model Area

Table 10.1.1 and Figure 10.1.2 (1) (2) depict the two-way peak-hour vehicular traffic volumes in the Model Area based on the survey by SMURT-KL in 1997.

Table 10.1.1 Vehicular Traffic Volume in the Model Area (1997)

Unit: PCU per two ways

Road	Range of Traffic Volume		
	16 Hours (6:00-22:00)	Morning peak hour (7:30-8:30)	Evening peak hour (17:00-18:00)
Jalan Pudu	44,820 -	4,050 -	1,770 -
Jalan Cheng Lock	42,680 - 19,010	4,140 - 1,280	3,200 - 500
Jalan Tun Perak	37.050 - 28,000	4,810 - 1,490	2,490 - 900
Jalan Raja Chulan	34,360 - 20,040	3,280 - 1,810	2,230 - 1,340
Jalan Gereja	27,020 - 13,880	1,600 - 1,200	930 - 740
Lebuh Pasar Besar	24,950 - 13,150	2,650 - 1,743	2,070 - 930
Jalan Tun HS Lee	27,410 - 4,100	1,400 - 280	2,210 - 260
Jalan Sultan	21,260 - 8,270	1,500 - 490	1,250 - 810
Lebuh Silang	21,250 - 6,240	610 - 410	1,230 - 410
Lebuh Ampang	18,500 - 13,810	1,820 - 1,560	1,660 - 820
Jalan Yap Ah Loy	13,960 -	2,160 -	840 -
Jalan Hang Lekiu	13,420 - 5,540	1,940 - 620	1,250 - 210
Jalan Petaling	13,370 - 4,520	1,770 - 850	1,220 - 30
Lebuh Pudu	11,050 - 6,360	740 - 370	1,150 - 550
Jalan Hang Kasturi	8,330 - 7,810	770 - 410	560 - 330
Jalan Medan Pasar	6,950 -	580 -	430 -

Source: SMURT-KL, JICA Study Team. Traffic Count Survey 1997.

2) Status of Traffic Congestion

a. Area with Traffic Congestion

In the area that constitutes KL's business and commercial centre, a substantial volume of traffic concentrates in the northern part of the Model Area bordered by Jln. Sultan Hishamuddin, Jln. Raja, Jln. Tun Perak, and Jln. Cheng Lock, causing heavy congestion within the area. In the morning peak hours, the traffic congestion in the above-mentioned area is caused by conflict between the heavy through traffic of commuters and the internal access traffic within the Model Area. On the other hand, the traffic congestion in the other half area located in the southern part of the Model Area is not serious.

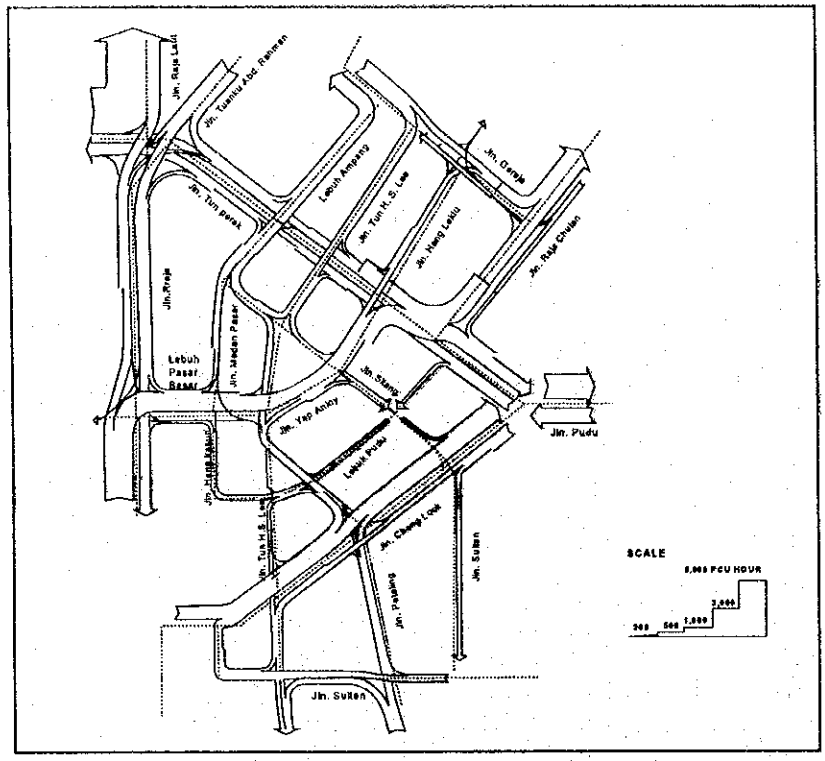


Figure 10.1.2 (1) Vehicular Traffic Volume Flow in the Morning Peak Hour

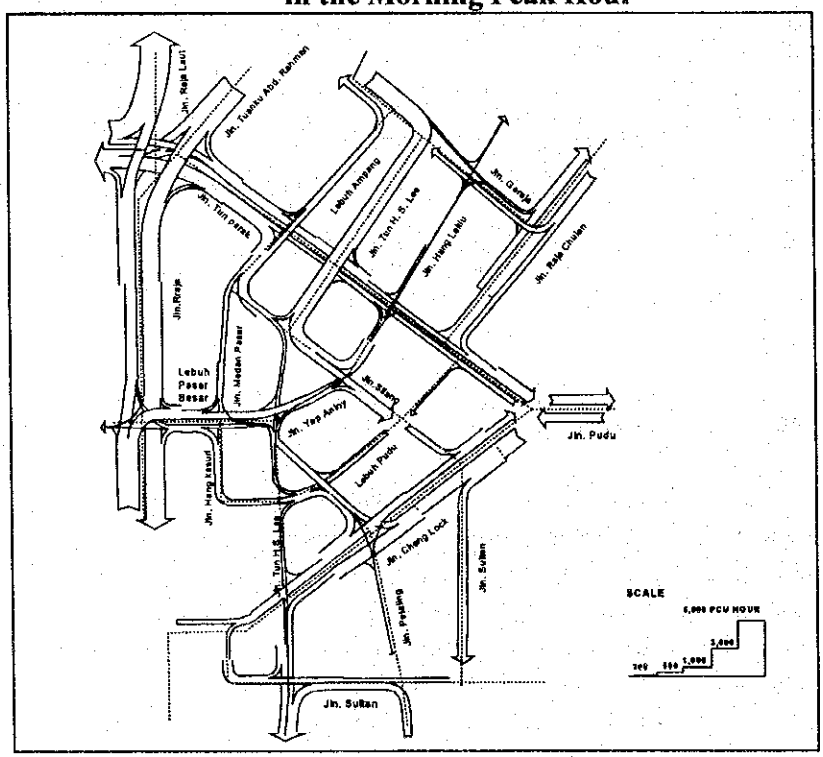


Figure 10.1.2 (2) Vehicular Traffic Volume Flow in the Evening Peak Hour

b. Degree of Saturation for Intersection

Table 10.1.2 shows the degree of saturation of the recent traffic volume count survey at twenty (20) intersections. Most of the intersections surveyed in the Model Area were observed to a saturation degree of more than 0.6. Three (3) intersections, particularly, had saturation degrees of more than 1.0. The values ranging from 1.0 to 1.1 indicate that these intersections are over-saturated. They are the Jln. Tun Perak - Hang Lekiu intersection, the Jln. Cheng Lock - Petaling intersection, and the Lebuh Pasar Besar - Jln. Raja intersection.

Obviously, if the saturation degree of an intersection exceeds 1.0, the design flow of the intersection cannot be handled satisfactorily. Such over-saturated conditions at those bottlenecks lead to long traffic jams.

Table 10.1.2 Saturation Degree of Intersections

Intersection		Rank of Saturation degree		
		0.1 - 0.5	0.6 - 1.0	Over 1.0
Jln. Tun Perak	- Jln. Pudu		●	
	- Jln. Hang Lekiu			●
	- Jln. Tun HS Lee	●		
	- Lebuh Ampang		●	
	- Jln. T. Abdul Rahman		●	
	- Jln. Raja Laut		●	
Jln. Cheng Lock	- Jln. Sultan		●	
	- Jln. Petaling			●
	- Jln. Tun HS Lee		●	
	- Jln. Hang Kasturi	●		
Jln. Gereja	- Jln. Raja Chulan		●	
	- Jln. Hang Lekiu	●		
Jln. Pasar Besar	- Jln. Raja			●
	- Jln. Hang Kasturi		●	
	- Jln. Tun HS Lee		●	
Jln. Yap Ah Loy	- Jln. Silang		●	
Jln. Sultan	- Jln. Tun HS Lee		●	
	- Jln. Petaling		●	
Jln. Silang	- Lebuh. Ampang	●		

Source: SMURT-KL, JICA Study Team. Traffic Count Survey 1997.

3) Through Traffic of Private Vehicles

a. Assumption of through traffic route

From the analysis of the traffic volume and the site observation survey, heavy through traffic comprising of private vehicles was observed in the Model Area during peak hours. In the morning peak hour, most of the through traffic travelled from the western part of Kuala Lumpur to the CBD. These through routes are composed of the two main gateways shown below:

i) Jln. Sultan Hishamuddin gateway route:

- from Jln. Damansara, Jln. Sultan Hishamuddin, Lebuh Pasar Besar, Jln. Yap Ah Loy, and Jln. Hang Lekiu toward Jln. Raja Chulan.

ii) Jln. Cheng Lock gateway route:

- from Jln. Syed Putra or Jln. Tun Sambantan, via Jln. Cheng Lock, Jln. Petaling, Jln. Tun HS Lee, Jln. Silang, Lebuh Ampang, and Jln. Gereja toward Jln. Ampang.

On the other hand, in the evening peak hours, most of the through traffic travelled from the north-eastern area of the CBD to the western part of Kuala Lumpur. Such through route entered from Jln. Gereja gateway as shown below:

iii) Jln. Gereja gateway route:

- from Jln. Ampang, via Jln. Gereja, Jln. Tun HS Lee, Lebuh Ampang, and Jln. Tun Perak toward the western part of Kuala Lumpur.
- from Jln. Ampang via Jln. Gereja, Jln. Tun HS Lee, Jln. Silang, Lebuh Pudu, Jln. Tun HS Lee, and Jln. Cheng Lock toward the western part of Kuala Lumpur.

b. Share of through traffic volume

The share of the current through traffic volume in the Model Area was estimated based on the traffic count survey. The share of through traffic to the total volume at each gateway in the morning peak hours (7:30-8:30) was about 85% at Jln. Sultan Hishamuddin gateway and about 70% at Jln. Cheng Lock gateway. On the other hand, in the evening peak hours (17:00-18:00), the share of through traffic at Jln. Gereja gateway via Jln. Tun Perak was 70%, while the share via Jln. Cheng Lock was approximately 15%. The ratio is particularly high on Jln. Sultan Hishamuddin gateway in the morning peak hours.

(2) Bus Traffic Flow Condition

1) Directional Bus Routes

At present about 250 bus routes operate as intra-city bus services in the city of KL. Of these, more than 130 routes enter the Model Area. Many bus routes run in the radial direction from/to the area forming a U-turn pattern and the rest also have a similar route structure. Most bus routes have terminus points in the Model Area. A substantial number buses are concentrated in the Model Area due to the duplication of routes caused by the U-turn pattern. This duplication of routes has led to an increase of total internal trips in the area. The directional bus routes of INTRAKOTA and PARK MAY companies are shown in Figure 10.1.3.

2) Bus Traffic Volume

a. Bus Traffic Passing the Model Area

Figure 10.1.4 shows the percentages of daily operation patterns of buses passing the Model Area. They are classified into five (5) patterns (northern, eastern, southern, western, and through-type patterns), based on the above-mentioned bus routes of INTRAKOTA and PARK MAY. The bus traffic share of the northern pattern had the highest figure, equivalent to 44% of the total bus traffic. It was followed by the eastern pattern (21%), southern pattern (17%), western pattern (2%), and through-type pattern (8%), respectively.

b. Bus Traffic Flow

Figure 10.1.5 shows the daily two-way bus traffic flow (INTRAKOTA, PARK MAY) on the roads in the Model Area based on the bus route registration. A substantial volume of buses was seen on the main access roads to the centre of the Model Area. The volume of buses on Jln. Tun H. S. Lee, Jln. Silang, Lebuh Pudu, Jln. Hang Kastri, Medan Pasar, Lebuh Pasar Besar, Jln. Yap Ah Loy, and Lebuh Ampang was between 770 and 1,400.

c. Bus Traffic Volume at Roadside

The daily two-way count of buses at major roadsides, based on the bus count survey, were: 2,660 on Jln. Ampang, 1,540 on Jln. Raja Chulan, 2,360 on Jln. Pudu, 470 Jln. Sultan, 1,500 on Jln. Sultan Mohamed, 1,660 on Jln. Cheng Lock, 2,610 on Lebuh Pasar Besar, 2,940 on Jln. Raja, and 360 Jln. Parlimen. The above-mentioned number of INTRAKOTA and PARK MAY buses was equivalent to 40 - 60% of the total number of buses at roadside. Peak hour ratios on the gateway routes into the Model Area varied from 2% to 11%, with an average of at about 7%.

(3) Traffic Facilities

1) Road System and Inventory

a. Road Network

Figure 10.1.6 shows the road network in the Model Area. The Model Area is traversed from east to west by two arterial roads which serve as corridors for the area. These arterial roads are Jln. Tun Perak and Jln. Cheng Lock. Several other roads radiating outwards from the centre of the Model Area also serve as arterial roads for the area.

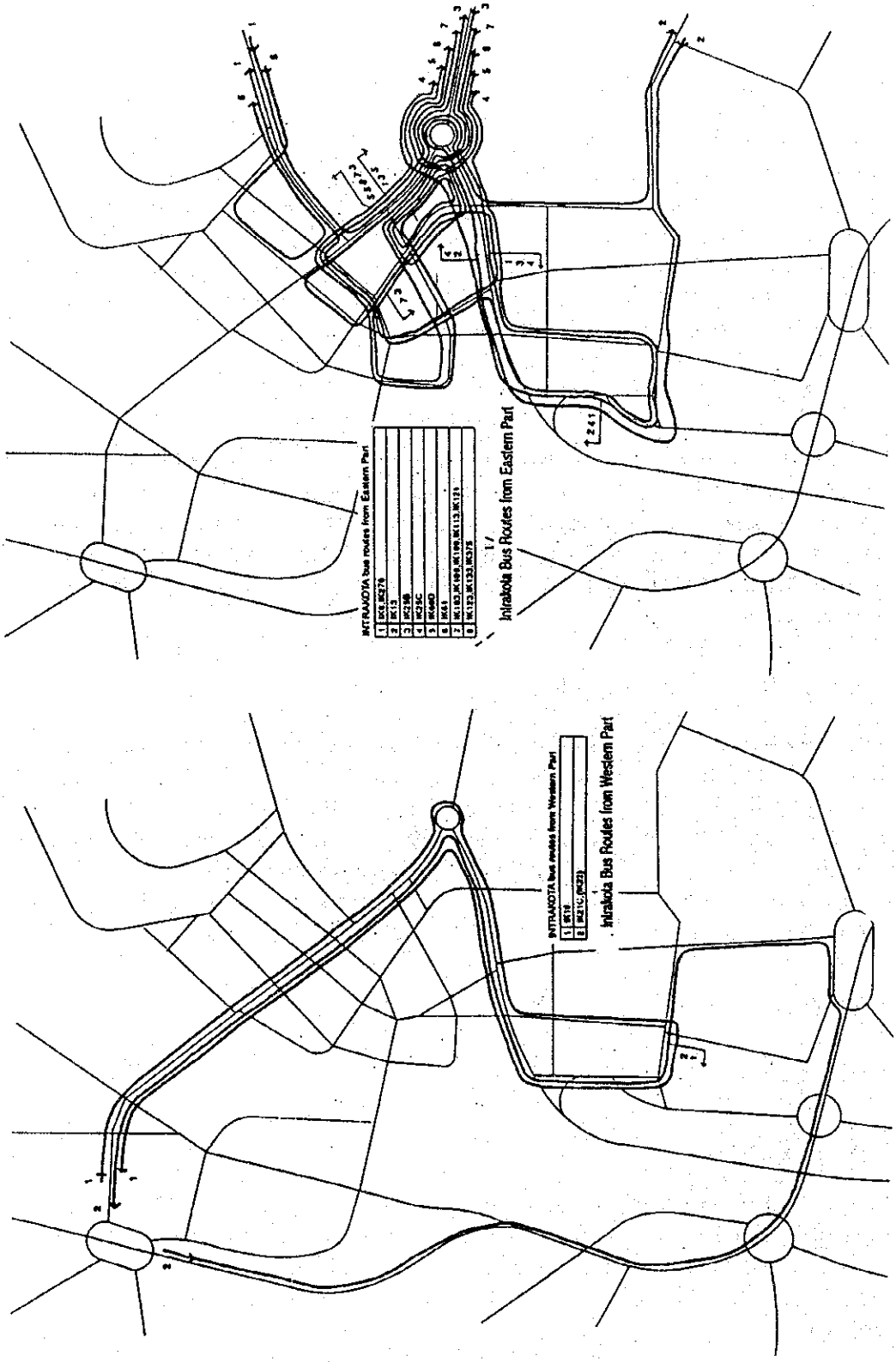


Figure 10.1.3 (1) Directional Bus Routes (INTRAKOTA and PARK MAY)

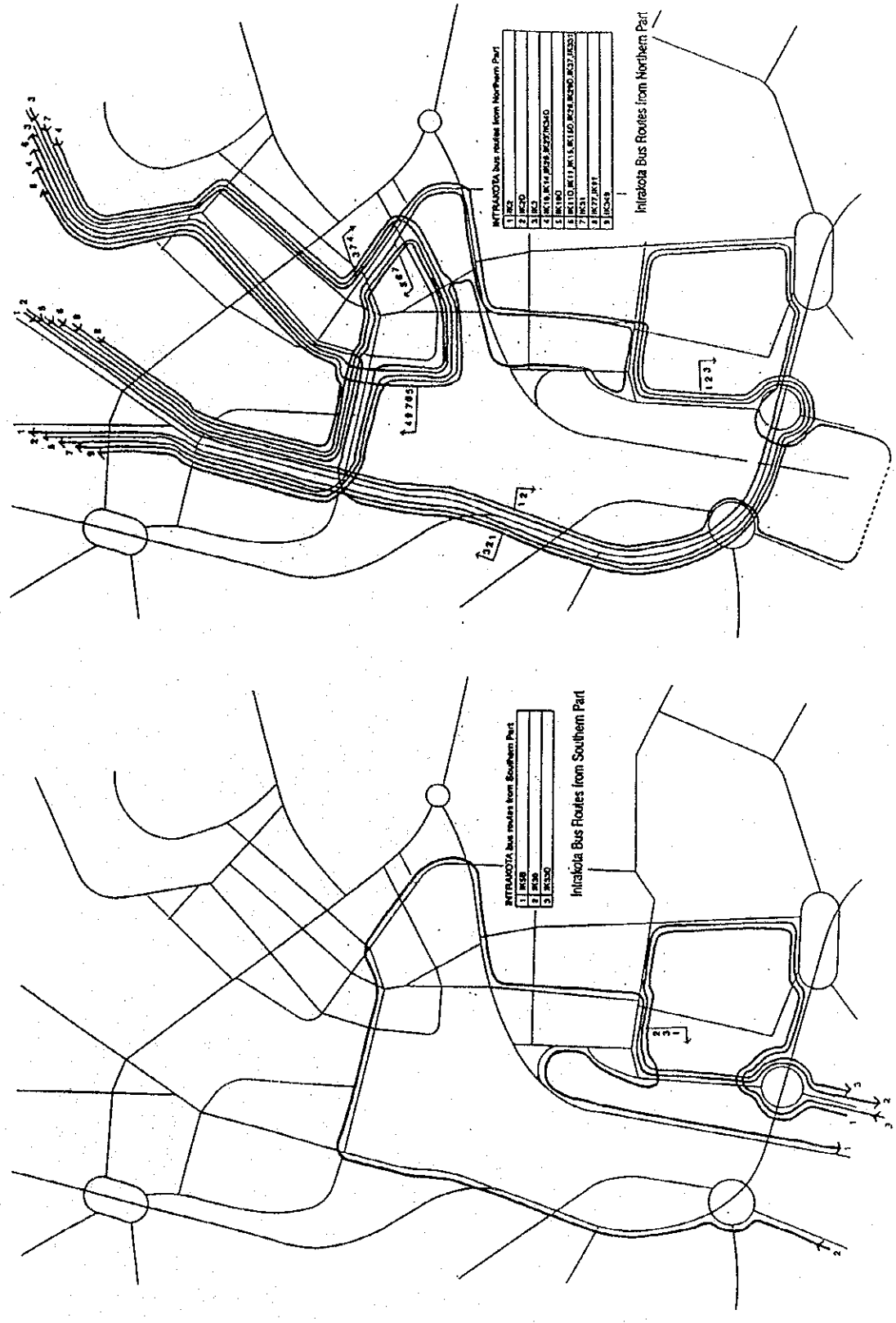


Figure 10.1.3 (2) Directional Bus Routes (INTRAKOTA and PARK MAY)

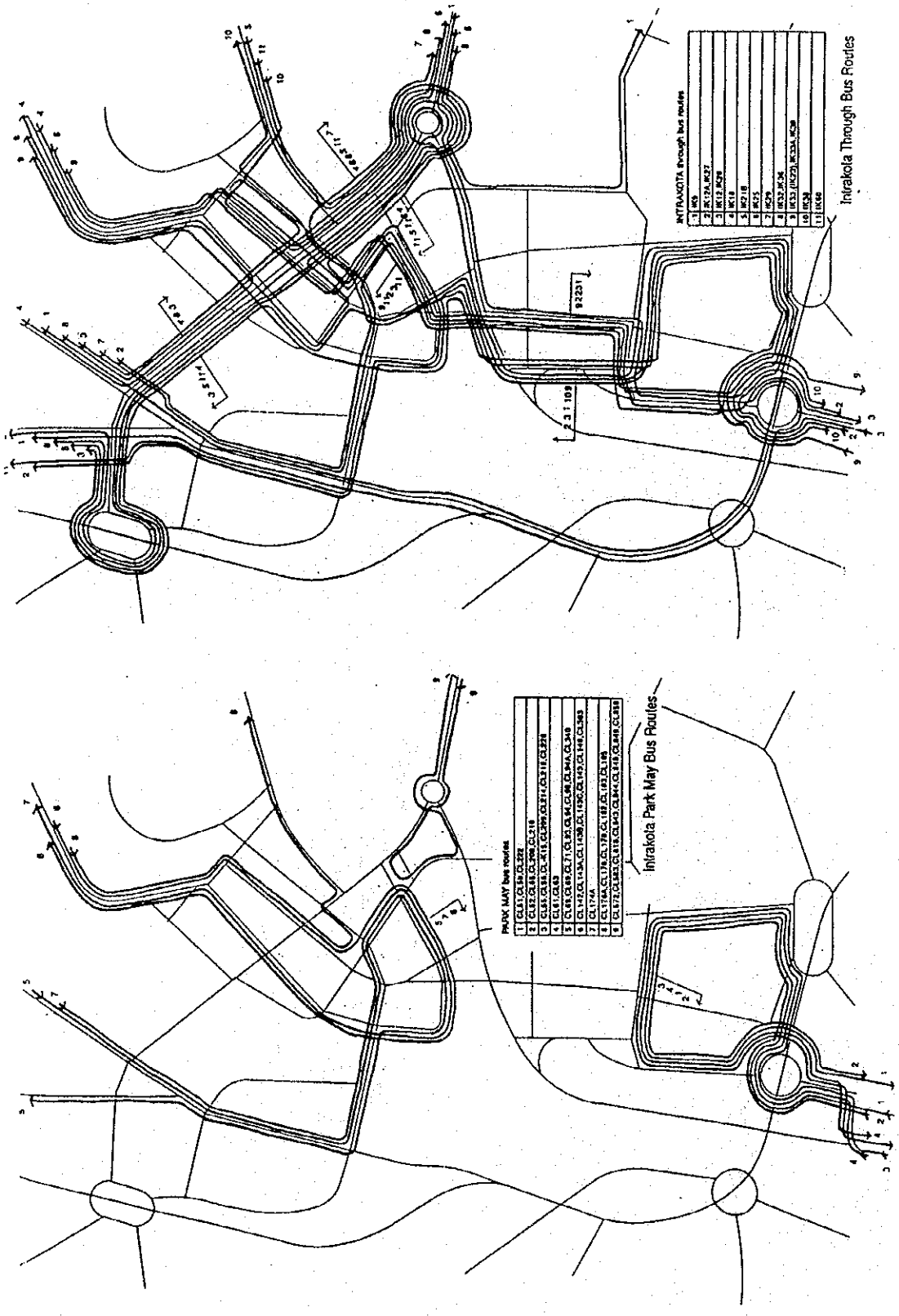


Figure 10.1.3 (3) Directional Bus Routes (INTRAKOTA and PARK MAY)

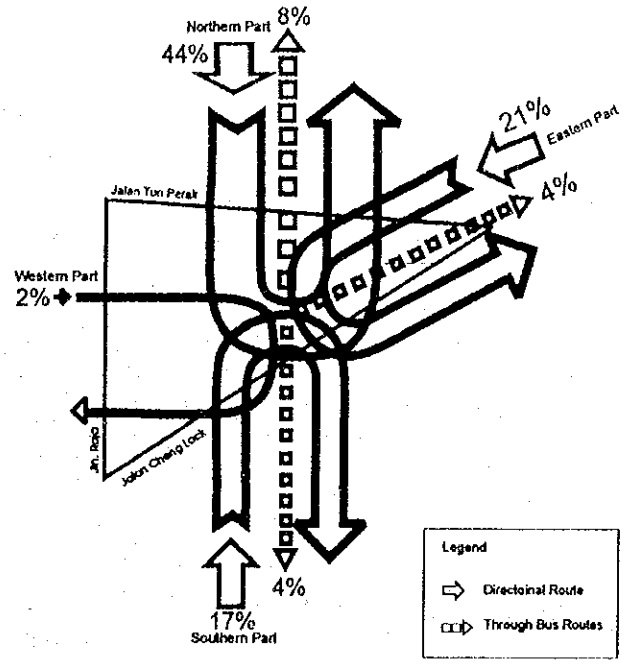


Figure 10.1.4 Bus Operating Pattern in the Model Area (INTRAKOTA, PARK MAY)

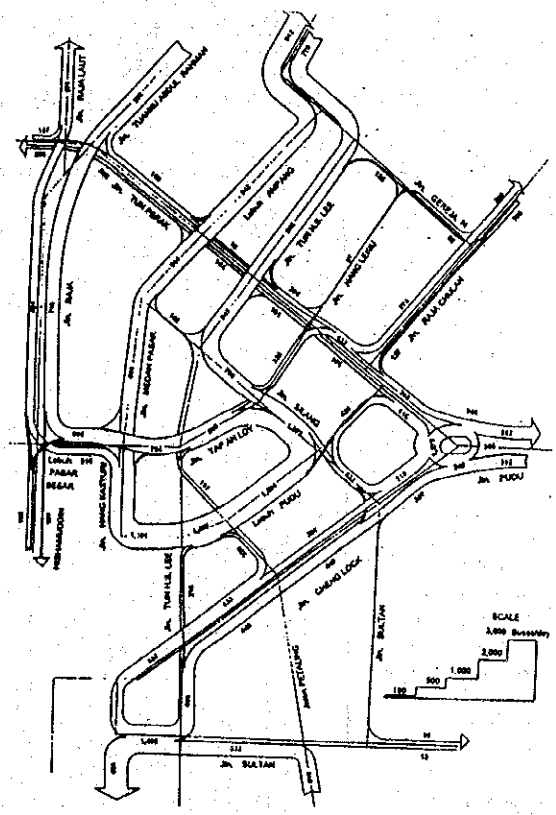


Figure 10.1.5 Bus Operating Volume Flow in the Model Area (INTRAKOTA, PARK MAY)

b. Width of Roads and Sidewalks

Figures 10.1.7 (1) and (2) show the width of road and sidewalks. Figure 10.1.8 shows the traffic facilities and street vendors. The number of lanes in the Model Area ranged from three (3) to four (4). The four-lane roads were: Jln. Geraja, Jln. Raja Chulan, Jln. Cheng Lock, Lebuh Ampang, Jln. Tun H. S. Lee, and Lebuh Pasar Besar.

Most sidewalks were not friendly to pedestrians. The average width was approximately 1.5 meters. This was especially true within the northern part of the Model Area. In spite of the narrow width of the sidewalks located alongside roads congested with buses, these sidewalks were being occupied by many street vendors.

2) Traffic Signal System

At present, there are eighteen (18) signalised intersections in the Model Area. These intersections are controlled by SCATS. Most of these signalised intersections, however, are manually controlled by traffic policemen during peak hours. The number of signal phase patterns at most intersections range only between 2 to 3 due to the one-way system. The signal cycle time at these intersections ranged from 37 to 390 seconds in the morning peak hours. The cycle time in the morning peak at the bottleneck intersections such as Jln. Tun Perak - Hang Lekiu, Jln. Cheng Lock – Petaling, and Lebuh Pasar Besar – Jln. Raja was longer, i.e., between 146 and 282 seconds due to the priority for heavy traffic directions (see Table 10.1.3).

Table 10.1.3 Signal Phase Patterns and Cycle Time Length

Intersection		Signal phase patterns			Cycle Time (sec)		
		AM Peak	OFF Peak	PM Peak	AM Peak	OFF Peak	PM Peak
Jln. Tun Perak	- Jln. Pudu	-	-	-	-	-	-
	- Jln. Hang Lekiu	2	2	2	219	111	43
	- Jln. Tun HS Lee	2	2	2	117	118	91
	- Lebuh Ampang	2	2	2	115	72	92
	- Jln. T. Abdul Rahman	3	4	5	142	148	194
	- Jln. Raja Laut	2	3	2	129	139	55
Jln. Cheng Lock	- Jln. Sultan	2	2	2	56	56	37
	- Jln. Petaling	3	3	3	146	111	154
	- Jln. Tun HS Lee	3	3	3	125	120	-
	- Jln. Hang Kasturi	2	2	2	107	110	104
Jln. Gereja	- Jln. Raja Chulan	3	2	2	117	77	75
	- Jln. Hang Lekiu	4	4	4	78	68	88
Jln. Pasar Besar	- Jln. Raja	3	5	5	282	142	146
	- Jln. Hang Kasturi	6	4	4	390	93	95
	- Jln. Tun HS Lee	2	2	2	67	50	39
Jln. Yap Ah Loy	- Jln. Silang	2	2	2	168	45	46
Jln. Sultan	- Jln. Tun HS Lee	2	2	2	91	82	113
	- Jln. Petaling	2	2	2	110	107	109
Jln. Silang	- Lebuh. Ampang	2	2	2	26	42	42

Source: SMURT-KL, JICA Study Team. Traffic Count Survey 1997.

Note: AM peak=7:30-8:30, OFF Peak=10:00-11:00, PM Peak=17:00-18:00

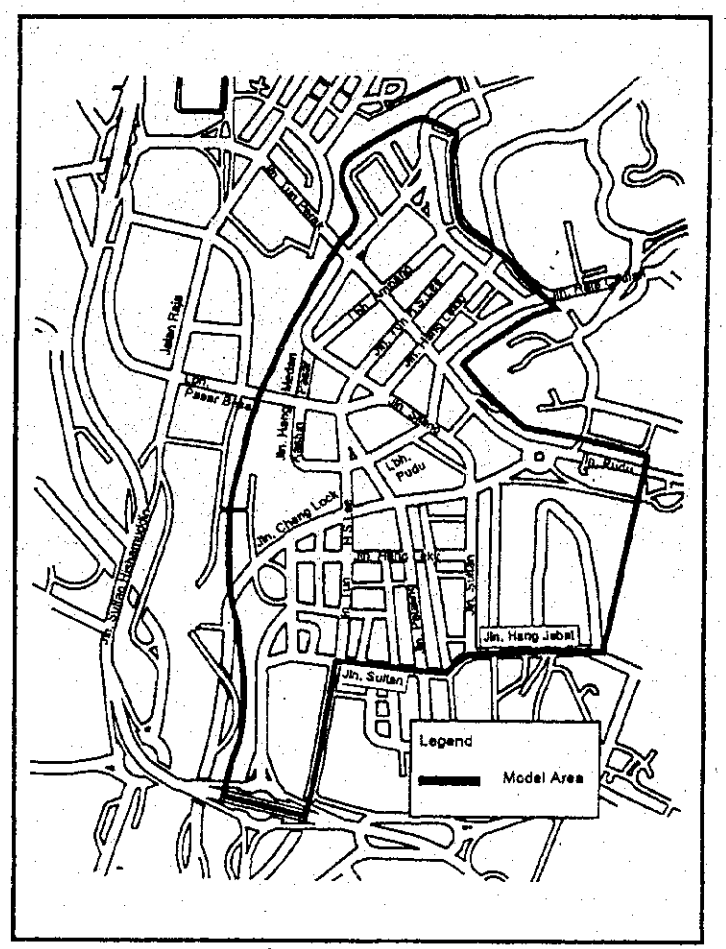


Figure 10.1.6 Road Network in the Model Area

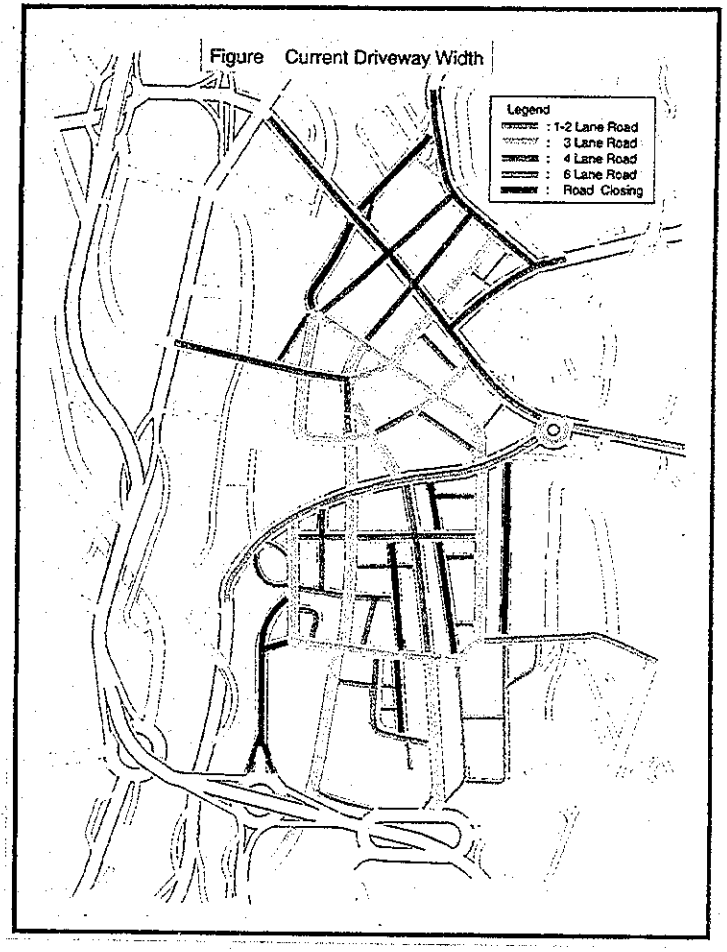


Figure 10.1.7 (1) Road Widths

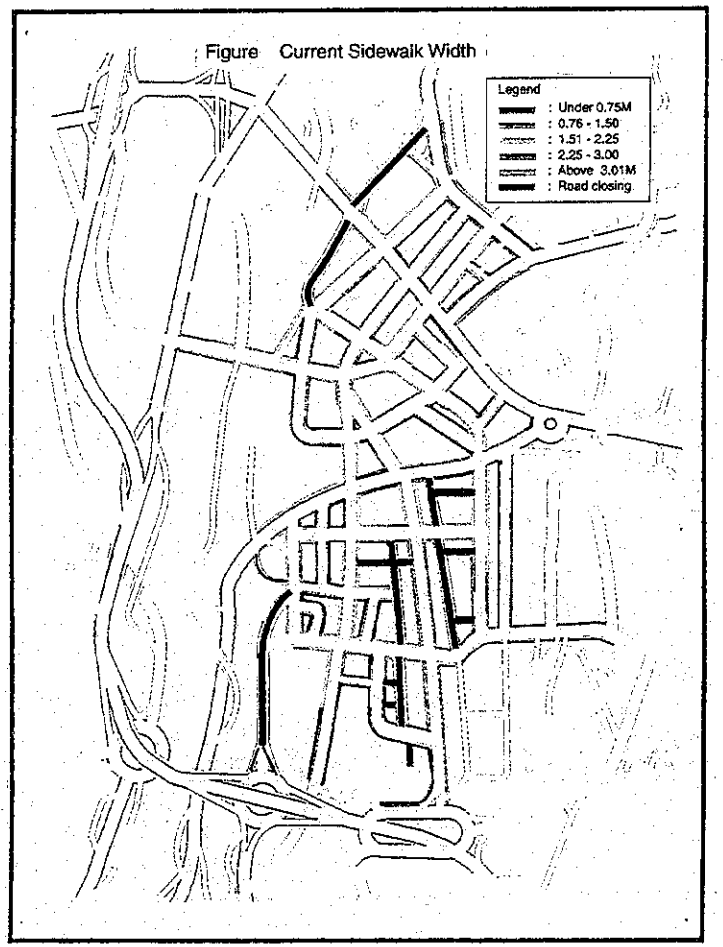


Figure 10.1.7 (2) Sidewalk Widths

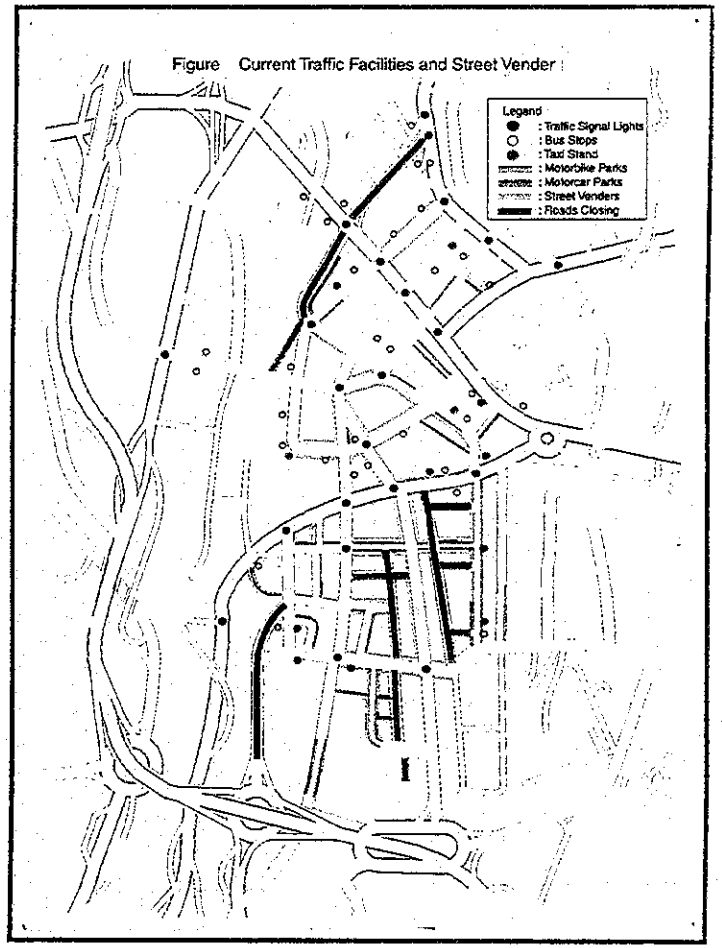


Figure 10.1.8 Traffic Facilities and Street Vendors

3) Traffic Regulation

Most roads in the Model Area are one-way streets, while the arterial roads such as Jln. Gereja, Jln. Raja Chelan, Jln. Tun Perak, and Jln. Cheng Lock are two way. Kerbside parking is prohibited on the major roads in the Model Area. In southern part of the Model Area, however, kerbside parking is allowed partly along Jln. Sultan and Jln. Hang Lekir.

4) Parking

At present, parking is strictly prohibited on every road, and car users have to park at parking lots designated along the streets or in off-street parking facilities.

10.1.3 Problems and Planning Issues

(1) Problems and Planning Issues on Vehicular Traffic

From the traffic engineering point of view, the following problems and planning issues on the vehicular traffic flow were identified in the Model Area. Table 10.1.4 is a summary of the problems and planning issues, while Figure 5.3.1 shows its main traffic problems and causes.

1) Serious Traffic Congestion due to Over-Saturation at Key Bottlenecks

The bottleneck points caused by roads with low traffic capacity were seen on the main intersections of major arterial roads accessing from/to the Model Area. The three seriously congested intersections were Jln. Sultan Hishamuddin - Lebuh Pasar Besar, Jln. Cheng Lock - Jln. Tun H. S. Lee, and Jln. Tun Perak - Jln. Hang Lekiu, which indicated a saturation degree of more than 1.0. They are the main gateways from the south-west and the north-west into the Model Area. The traffic congestion with the spill-back problem were due to the bottlenecks which aggravated the circulation of traffic flow in the Model Area.

In the morning peak hours, the bottlenecks were caused by the crossing through traffic as seen on the main access roads in the north of the Model Area. One of the serious examples was Lebuh Pasar Besar - Jln. Tun H. S. Lee intersection, where Jln. Cheng Lock gateway route merges with Jln. Sultan Hishamuddin gateway route. The spill-back caused by this bottleneck extended toward all the gateways. Similar situations could be observed at Jln. Sultan Hishamuddin - Lebuh Pasar Besar intersection and Jln. Cheng Lock - Jln. Tun H. S. Lee intersection. In the evening peak hours, such a bottleneck was observed at Jln. Yap Ah Loy - Jln. Silang intersection.

Table 10.1.4 Identification of Problems and Planning Issues

Current problems	Planning Issues	
1. **Vehicle Traffic flow** a. Serious traffic congestion due to over-saturation	- Increase of capacity for key bottlenecks	a. Improvement of key bottlenecks by channelization b. Effective one-way system c. Effective coordinate signal control system
b. Heavy through traffic in the Model Area	- Reduction of through traffic	a. Zone system b. Effective one-way system by using loop type
	- Through traffic route should be minimised	a. Through traffic priority road without bus routes b. Effective one-way system for through traffic
2. **Public Transport** a. Duplication of existing bus routes	- Reduction of total trips by bus re-routing	a. Re-routing without buses conflict (in Model .Area) b. Relocation of through bus routes (whole area) c. Cross linking without terminus points in CBD (Whole area)
b. Conflict among buses - Buses conflict near bus stops - Blocking of buses due to left/right turning - Conflict due to bus weaving	- Priority facilities for buses	a. Bus transit mall system b. Bus priority lane system
	- Reduction of bus conflict by bus re-routing	a. Re-routing without buses conflict (in Model .Area) b. Relocation of through bus routes (whole area) c. Cross linking without terminus points in CBD (Whole area)
	- Reduction of bus conflict by bus priority	a. Bus transit mall system b. Bus priority lane system
c. Pedestrians/passengers overflow onto vehicle lanes	- Widening of sidewalk	a. Relocation of street venders b. Improvement of sidewalk with bus transit mall system
3. **Traffic Facilities** a. Insufficient road capacity	- Separation among buses/cars routes	a. Through traffic priority road without bus routes b. Bus transit mall system c. Bus priority lane system
b. No pedestrian-friendly due to narrow sidewalk	- Widening of sidewalk	a. Relocation of street venders b. Improvement of sidewalk with bus transit mall system
c. Unsuitable corner cut on bus routes	- Priority for pedestrian routes - Priority facilities for buses	a. Pedestrian mall system a. Bus transit mall system b. Bus priority lane system
d. Unsuitable traffic signal control system	- Reduction of bus conflict by bus re-routing - Improvement of traffic signal control system	a. Re-routing without buses conflict (in Model .Area) a. Technical improvement to manage

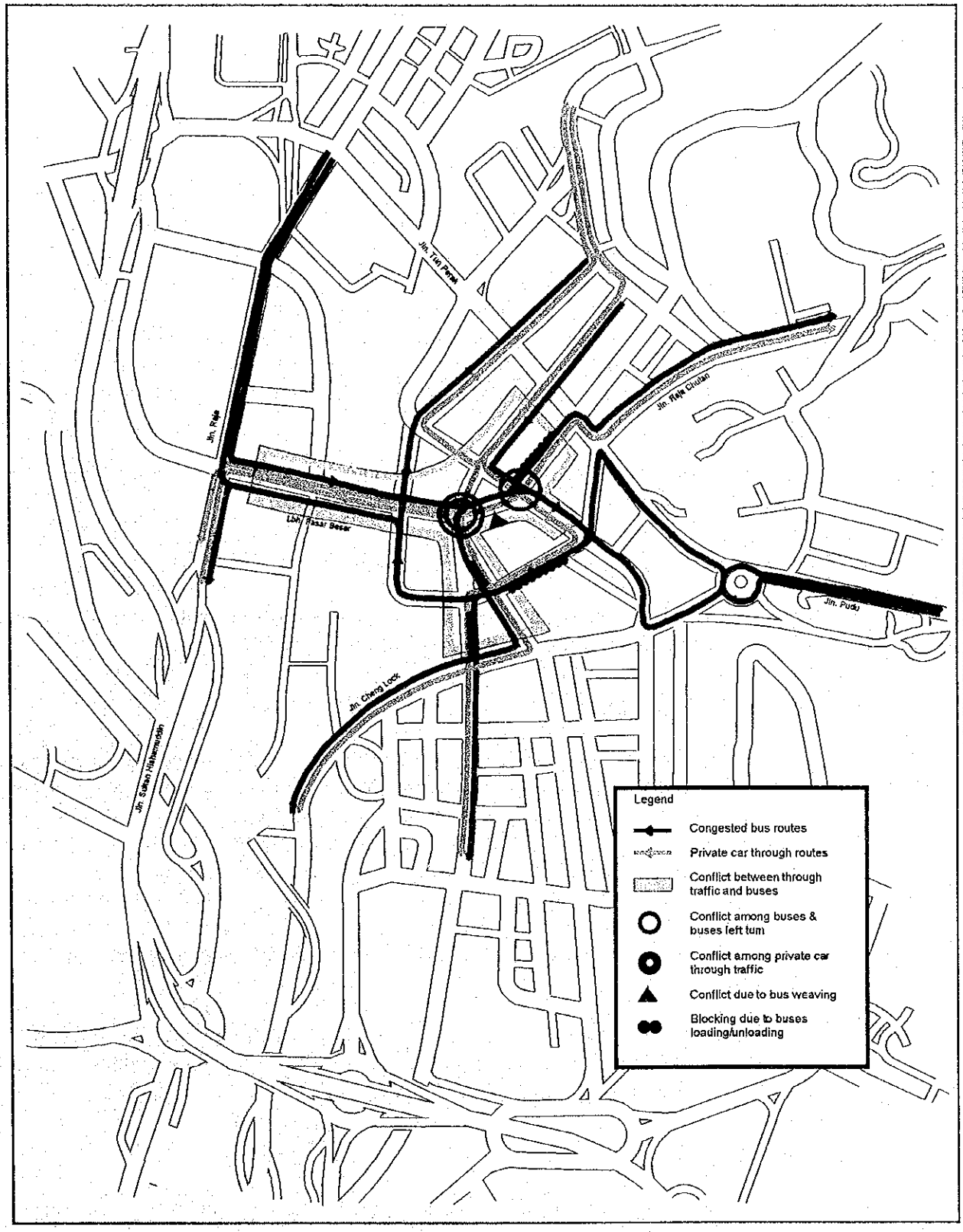


Figure 10.1.9 Main Traffic Problems and Causes

At present, the physical remedy to increase traffic capacity, such as the widening of the roadway is difficult. Road capacity, however, could be increased by means of a control method of through traffic.

2) Heavy Through Traffic in the Model Area

The heavy through traffic crossing the Model Area during peak hours has hindered intra-area private car traffic and socio-economic activities in the Model Area. The congested segments were caused by the conflict between the through traffic and buses concentrating along Lebuh Pasar Besar - Jln.. Yap Ah Loy - Jln.. Tun Perak - Jln. Raja Chulan. As stated above, the intersection of Lebuh Pasar Besar - Jln. Tun H. S. Lee is a key bottleneck of the through traffic. In addition, main roads such as Lebuh Pasar Besar, Jln. Yap Ah Loy, Jln. Petaling, Jln. Hang Lekiu, Jln. Tun H. S. Lee, Jln. Silang, and Lebuh Pudu had heavily congested segments due to the conflict between through traffic and buses.

Therefore, it is necessary to reduce heavy through traffic in the above-mentioned areas and to minimise the through traffic route.

(2) Problems and Planning Issues on Public Transport

From the traffic engineering point of view, the following problems and planning issues on the public transport have been identified in the Model Area.

1) Duplication of Bus Routes

A substantial number of buses concentrate in the above-mentioned traffic congested areas. Critically heavy traffic congestion was seen on each access road, indicating the conflict between buses and pedestrians. Many bus routes run in a radial direction from/to the area and the duplication of bus routes have resulted in a similar route structure. The directional bus routes with terminus point in the Model Area are characterised by a U-turn pattern. This leads to an increase of the total internal bus trips and congestion among buses in the area. An example of a congested intersection due to the crossing of major bus routes is Jln. Yap Ah Loy - Jln. Silang intersection.

The duplication of bus routes implies the necessity to overcome this flow by re-routing, i.e., eliminating the conflict between bus traffic and vehicular through traffic, or among the bus routes themselves.

2) Conflict among Buses

Some bottlenecks were caused by buses stopping near bus stops or on the fringe of crossings of major bus routes as seen on the access roads in the Model Area. For instance, they would try to squeeze into a queue of buses and block the intersection. Two buses would often stop/drive in parallel on a two- or three-lane road, becoming

major obstacles. These congested segments are Jln. Hang Lekiu between Jln. Silang and Jln. Tun Perak, Lebuh Pudu between Jln. Silang and Jln. Petaling, Jln. Petaling between Lebuh Pudu and Jln. Yap Ah Loy, and Jln. Tun HS Lee between Lebuh Pudu and Jln. Cheng Lock. In addition, buses were also seen weaving on Jln. Yap Ah Loy. Since the cut on the road corner at major crossings is too short, large buses making a left/right turn frequently block the intersection. Seriously congested segments due to the stopping buses as were observed on Jln. Silang. Furthermore, the traffic spill-back extended downstream.

It is, therefore, highly recommended that more effective bus routes be reconsidered in order to improve the conflict of through traffic and the conflict among buses, along with the bus priority system.

3) Overflow of Pedestrians/Passengers onto Carriageways

The area congested by buses is bordered by Jln. Cheng Lock, Jln. Tun Perak, Lebuh Ampang, Medan Pasar, Jln. Hang Kasturi, and Lebuh Pudu. Many pedestrians and passengers flow onto the carriageways near bus stops due to the small capacity of sidewalks. On top of that, street vendors have occupied most of the narrow sidewalks, particularly, on Lebuh Pudu.

Most sidewalks are not pedestrian-friendly, because, the widths of the sidewalks are not wide enough. Hence, widening of sidewalks by relocating street vendors to open spaces such as pedestrian roads would be required.

(3) Problems and Planning Issues on Traffic Facilities

From the traffic engineering point of view, the following problems and the planning issues on traffic facilities in the Model Area have been identified.

1) Insufficient Road Capacity

The congestion in the northern part of the Model Area occurs during peak hours, when major signalised intersections become saturated and travelling speed becomes low. The major roads in the area were observed to have an insufficient road capacity. Therefore, the road capacity should be increased by means of demand control and separation of buses from the vehicular through traffic.

2) Unfriendly Pedestrian Environment due to Narrow Sidewalks

The width of sidewalks on the major roads in the Model Area is not ideal for pedestrians. Along with the introduction of a bus priority system or the relocation of street vendors, the sidewalks should be improved and widened.

3) Unsuitable Corner Cut on Bus Routes

Traffic congestion problems caused by large buses turning left/right were after observed in the Model Area. Since it is difficult to improve the corner cut of the current road due to the limited space, it is recommended that an exclusive route for buses and to re-route the buses be created.

4) Unsuitable Traffic Signal Control System

It should be noted that the existing traffic signal control system in the Model Area is effective only when the traffic volume is under the level of saturation. The road capacity of the arterial roads such as Jln. Cheng Lock and Jln. Tun Perak in the Model Area must be sufficient enough to cope with the high volume of traffic flow in the area. In the case of an over-saturated intersection, technical improvements to manage the high traffic volume should be considered.

10.1.4 Strategy on Alternatives for the Immediate Action Plan

(1) Objective

The objective of the immediate action plan in the Model Area is to vitalise the CBD by allowing it to function more effectively, promoting an attractive urban environment and ensuring smooth flow of traffic. The goal of this plan is to induce commuters to shift from private vehicles to public transport. The basic policies and strategies entitled in the plan are described below.

(2) Premises for Development of Alternative Plans

The premises for development of alternative plans are described below:

- The immediate action plan is proposed as a short-term measure for the next couple of years. It should follow the middle-term plan of the Master Plan on Integrated Urban Strategies for Environmental Improvement.

- The study area for the immediate action plan, as shown in Figure 10.1.10, covers the seriously congested area (hereinafter referred to as "action plan area"). The action plan area is bordered by Jln. Gereja in the north, Jln. Cheng Lock in the south, the Puduraya roundabout in the east, and Sungai Klang in the west.

- The proposed immediate action plan emphasises the maximum use of the existing road facilities, and a trial-error method shall be carried out by observing the effects on the traffic flow. Therefore, it is necessary to introduce traffic improvement measures which respond to the changing traffic patterns at different times of the day.

- The strategy of the plan calls for the control of the traffic flow in the action plan area through strong traffic regulation. The plan then should be implemented in such a way that the citizens gradually become accustomed to such regulation through the sufficient information provided to the public.

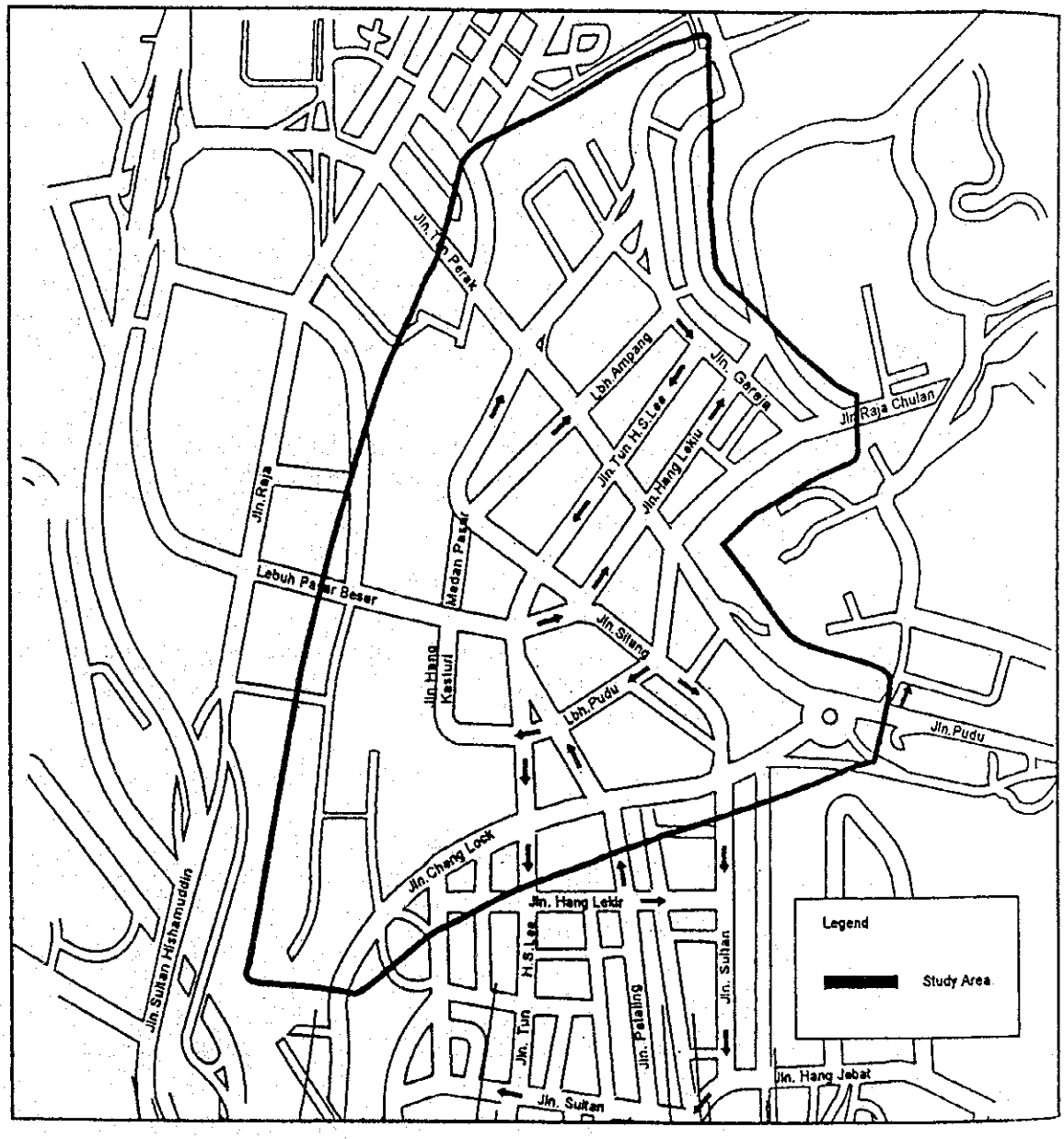


Figure 10.1.10 Study Area for the Immediate Action Plan

(3) Basic Policies and Strategies

The action plan area is a densely developed area that functions as a centre for the commercial and business activities. In the peak hours, all major roads in the area are congested due to the high concentration of commuters and commercial and business activities. The congestion is causing numerous problems, including the deterioration of the overall environment and the commercial and business activities. The bus congestion and the heavy through traffic are particularly serious.

The first objective of the transport improvement plan for the action plan area must be to maintain and support the commercial and business activities of the district at a sound level. Therefore, in addition to ensuring the smooth traffic flow of vehicular traffic, the plan must consider creating an attractive urban environment that is amenable to pedestrians as well as to motorists.

Owing to the density of buildings in the action plan area, it will be difficult to improve the road capacity to meet the demands of an ever-increasing traffic despite unlimited investment in new road construction. The time has come to start regulating the inflow of private vehicles by various traffic restrictions and increasing the use of the public transport facilities.

A traffic system that takes into account the following basic policies and strategies based on the issues is envisioned for the action plan area. The basic policies and strategies are shown as follows:

1) Major issues

- The increase in vehicular traffic will be dealt with by making appropriate use of the existing traffic facilities in the action plan area. Improvement of the traffic facilities shall be minimised if possible.
- Traffic that does not originate or end within the action plan area shall be restricted to certain roads.
- The pedestrian environment shall be improved in order to ensure their safety and enhance the commercial functions of the action plan area.

2) Basic policies

- Public transportation facilities will be improved in order to induce commuters to shift from private vehicles to public transport.
- Roads will be given separate functions, and through traffic will be segregated in order to improve the flow of traffic originating and ending in the action plan area.
- More pedestrian-friendly space will be provided in order to improve the overall traffic environment in the urban area.

3) Strategies

- The function of public transportation facilities will be clarified, and the system of transportation will be improved by introducing bus re-routing, bus priority lanes, and bus transit malls.
- Based on the separate road functions, roads which have access to major arterial roads will be clearly distinguished in the area.
- Through traffic which does not originate or end within the area will be restricted by introducing a separation system between buses and private vehicles.
- Pedestrian space will be provided in the overall traffic system by introducing pedestrian malls and relocating street vendors.

(4) Bus Re-routing Plan

In order to address the strategies and measures of bus transportation facilities presented in the previous sections, the arrangement plan for bus routes is formulated based on the current INTRAKOTA/PARK MAY directional bus operating routes and operating volume. Bus re-routing is an important premise for the development of alternative plans. Since the existing road traffic capacity has almost reached the near-saturation degree, it is, therefore, essential to create more road capacity by reducing the total duplicate bus trips.

1) Re-routing Method

The re-routing of bus routes with terminus point in the action plan area comprises of re-routing involving the whole KL city and re-routing in the action plan area. The bus re-routing method which involves the whole KL city is described as below.

a. Re-routing Involving the Whole KL City

Since many of the existing U-turn pattern routes with terminus point in the action plan area have duplicate routes, such U-turn patterns should be changed into through patterns by combining the north-south and north-east routes. The bus routes should be improved in order to reduce the U-turn activities of the existing bus routes.

As shown in Figure 10.1.11, the advantages would not only be the reduction of total bus trips in the action plan area, but also the reduction of the conflict among buses. On the other hand, the disadvantage is that the through pattern routes will have a longer operating time. The model of bus operation should take into consideration the supply and demand of different bus routes.

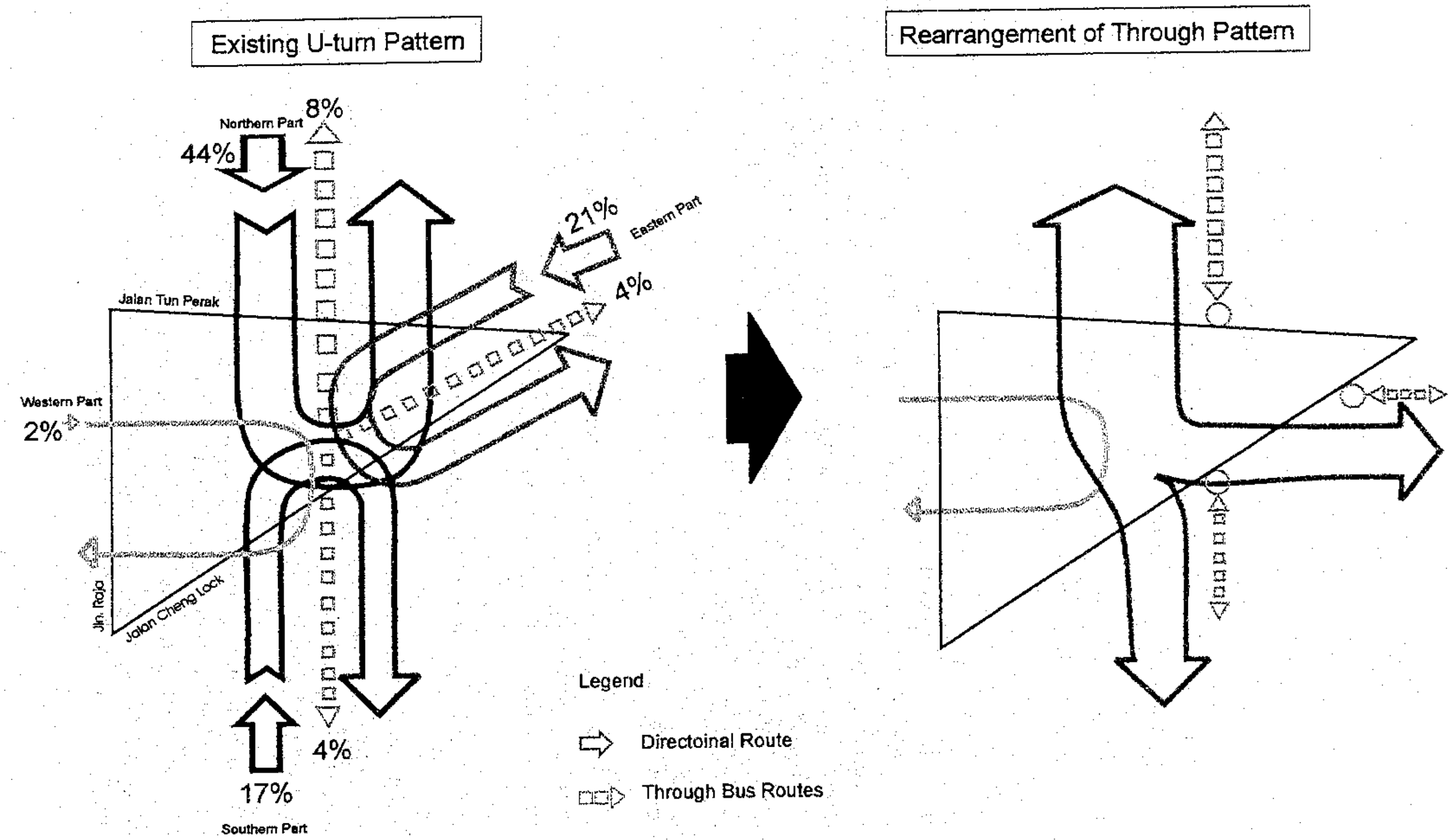


Figure 10.1.11 Bus Re-routing Method

Figure 10.1.12(1)(2) shows the result of the re-routing which shows a shift from the existing U-turn patterns to through patterns. The long distance type bus routes of PARK MAY will not be considered for re-routing due to its long operating travel time. The INTRAKOTA bus routes are classified into two (2) types: routes with terminus points and those without terminus points in the action plan area. The daily bus operating volume passing the action plan area is again classified into five (5) patterns such as northern, eastern, southern, western, and through-type patterns.

Regarding the existing bus routes with terminus points in the action plan area, about 48% of the total operating volume from the north (total approximately 770 buses) are expected to combine with those from the east, while 4% of buses from the north combine with those from the south. Meanwhile, 70% of through-type buses are expected to combine with those of the north-south patterns (total approximately 310 buses).

On the other hand, 90% of the total operating volume from the south (approximately 70 buses) are expected to combine with buses from the north, and about 60% of total buses (about 90 buses) from the east are expected to combine with those from the west.

b. Re-routing in the Action Plan Area

Re-routing should be carried out for better public transportation service in the action plan area. This re-routing will also act as a barrier against the through traffic. Taking the walking distance into consideration, the bus service area is the area within 250-300 m of the bus stops, based on the pedestrian walking distance survey. The alternatives for bus re-routing are recommended based on the following premises.

- Based on the above-mentioned through pattern re-routing method, the bus routes need to be improved in order to reduce the U-turn movements of the existing buses with terminus points in the action plan area.

- The bus routes ought to be improved in order to reduce the duplication of bus routes and to avoid conflict among buses.

- Buses should be excluded from Lebuh Pudu, Jln. Hang Kasturi, and Medan Pasar since they are important for internal access traffic and they serve as a part of the circumferential roads.

- The major through route of Lebuh Pasar Besar - Jln. Yap Ah Loy - Jln. Hang Lekiu will be identified from the viewpoint of both vehicular through traffic and the bus traffic.

- The re-routing of buses turning right onto the major arterial roads will be avoided except for existing routes, if possible.

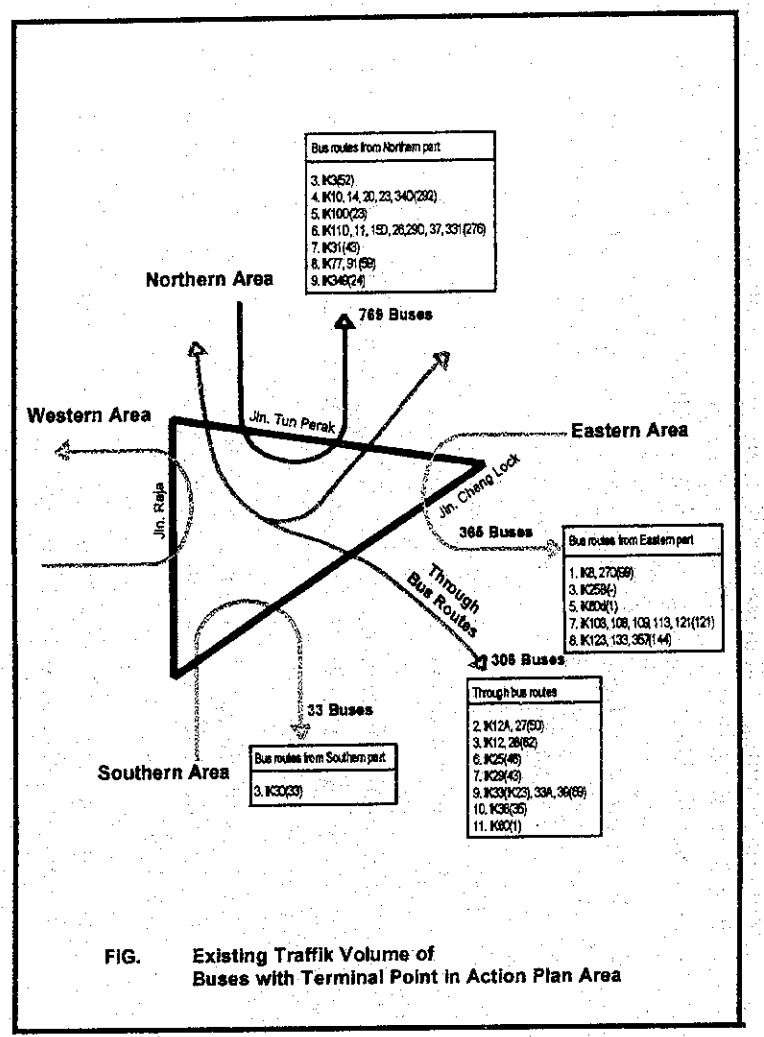


FIG. Existing Traffik Volume of Buses with Terminal Point in Action Plan Area

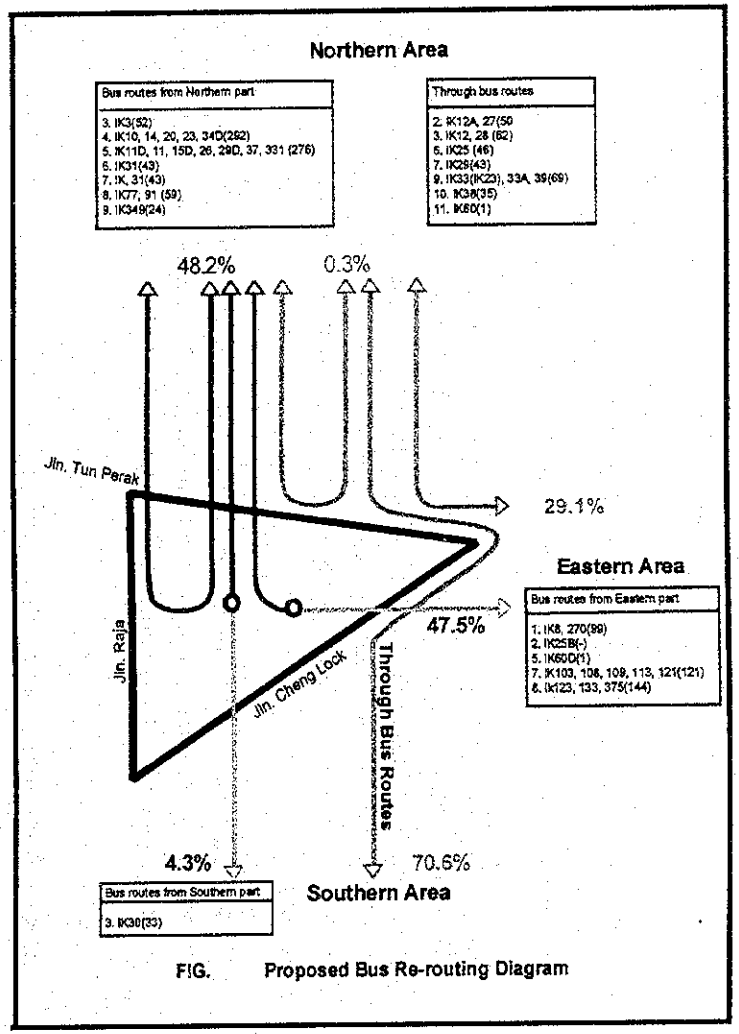


FIG. Proposed Bus Re-routing Diagram

Figure 10.1.12(1) Concept of Bus Re-routing with Terminus Points in the Action Plan Area

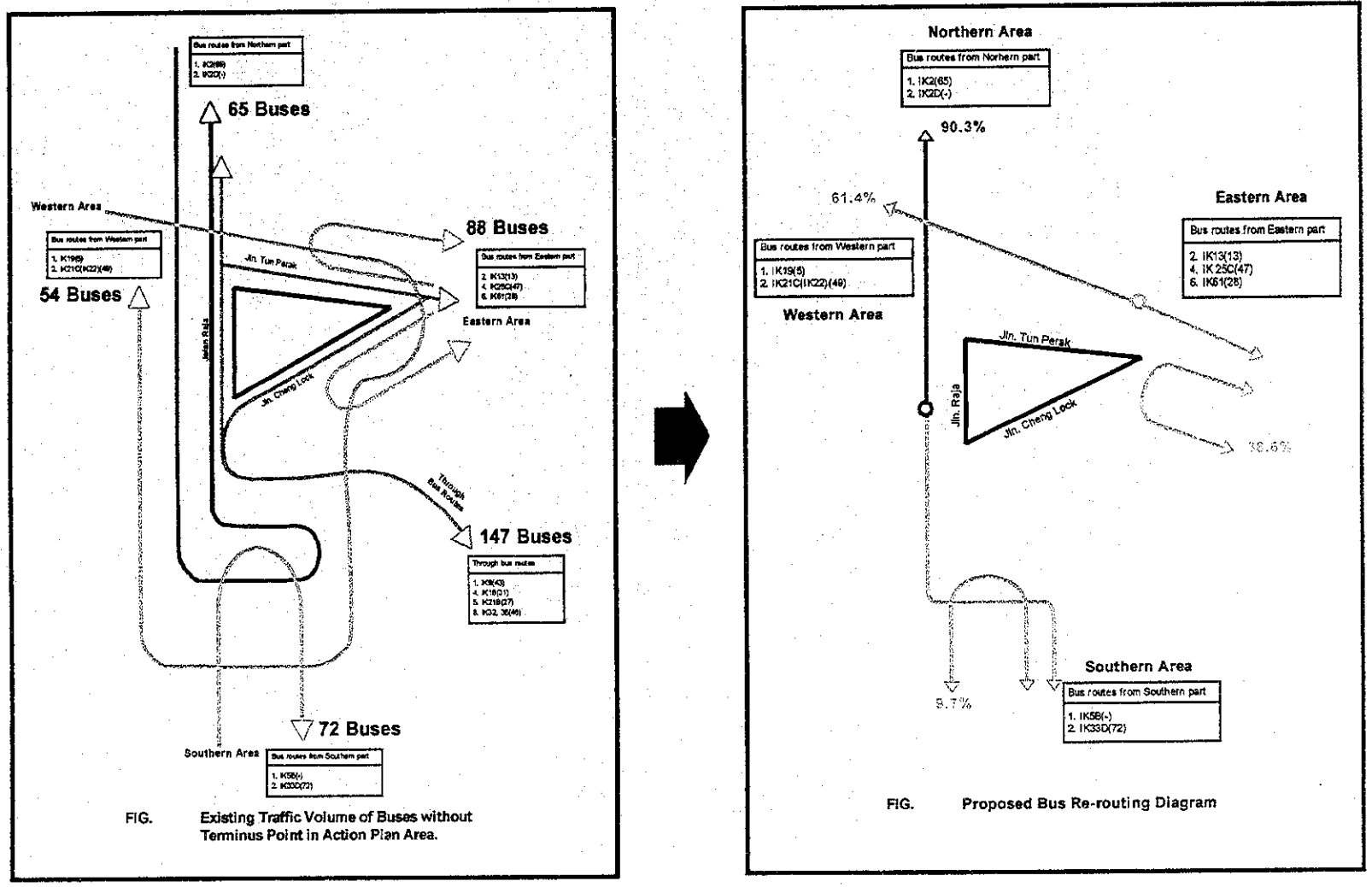


Figure 10.1.12(2) Concept of Bus Re-routing with Terminus Points in the Action Plan Area

2) Bus Re-routing Alternatives

Based on the foregoing section, four (4) alternatives were determined for the re-routing in the action plan area, as shown in Figure 10.1.13.

i) Alternative 1

Under Alternative 1, the bus routes will be separated from the major through traffic route (Lebuh Pasar Besar - Jln. Yap Ah Loy - Jln. Hang Lekiu) in order to improve the flow of buses on congested roads. The main route in the central part of the action plan area is connected to the circumferential road, through the Lebuh Pudu - Jln. Hang Kasturi - Medan Pasar - Jln. Tun Perak - Jln. Tun H. S. Lee - Jln. Silang route. The gateways to the action plan area are Lebuh Pudu in the north and Jln. Tun HS Lee in the east.

ii) Alternative 2

Alternative 2 is the same as Alternative 1 except that, instead of the Jln. Hang Lekiu - Medan Pasar route, the route has been changed to the Jln. Petaling - Jln. Tun H. S. Lee route.

iii) Alternative 3

Alternative 3 is the same as Alternative 2 except that the Lebuh Pudu route has been eliminated because of its narrowness. The gateways to the action plan area are divided into northern, eastern, and southern parts. This plan distinguishes the functions of different routes according to the traffic types; that is, the through traffic will be on route Lebuh Pasar Besar - Jln. Yap Ah Loy - Jln. Hang Lekiu, and buses and internal access traffic will be on Lebuh Pudu - Jln. Hang Kasturi - Medan Pasar - Lebuh Ampang.

iv) Alternative 4

Under Alternative 4, the bus route is separated from the through traffic route (Jln. Cheng Lock - Jln. Petaling - Jln. Tun H. S. Lee (or Jln. Yap Ah Loy - Jln. Hang Lekiu) - Jln. Silang - Lebuh Ampang) in order to improve the flow of buses on congested roads. However, a route has been added in this alternative to provide a the gateway for the through traffic from Lebuh Pasar Besar. The gateways to the action plan area are Lebuh Pasar Besar from the north and Jln. Tun HS Lee.

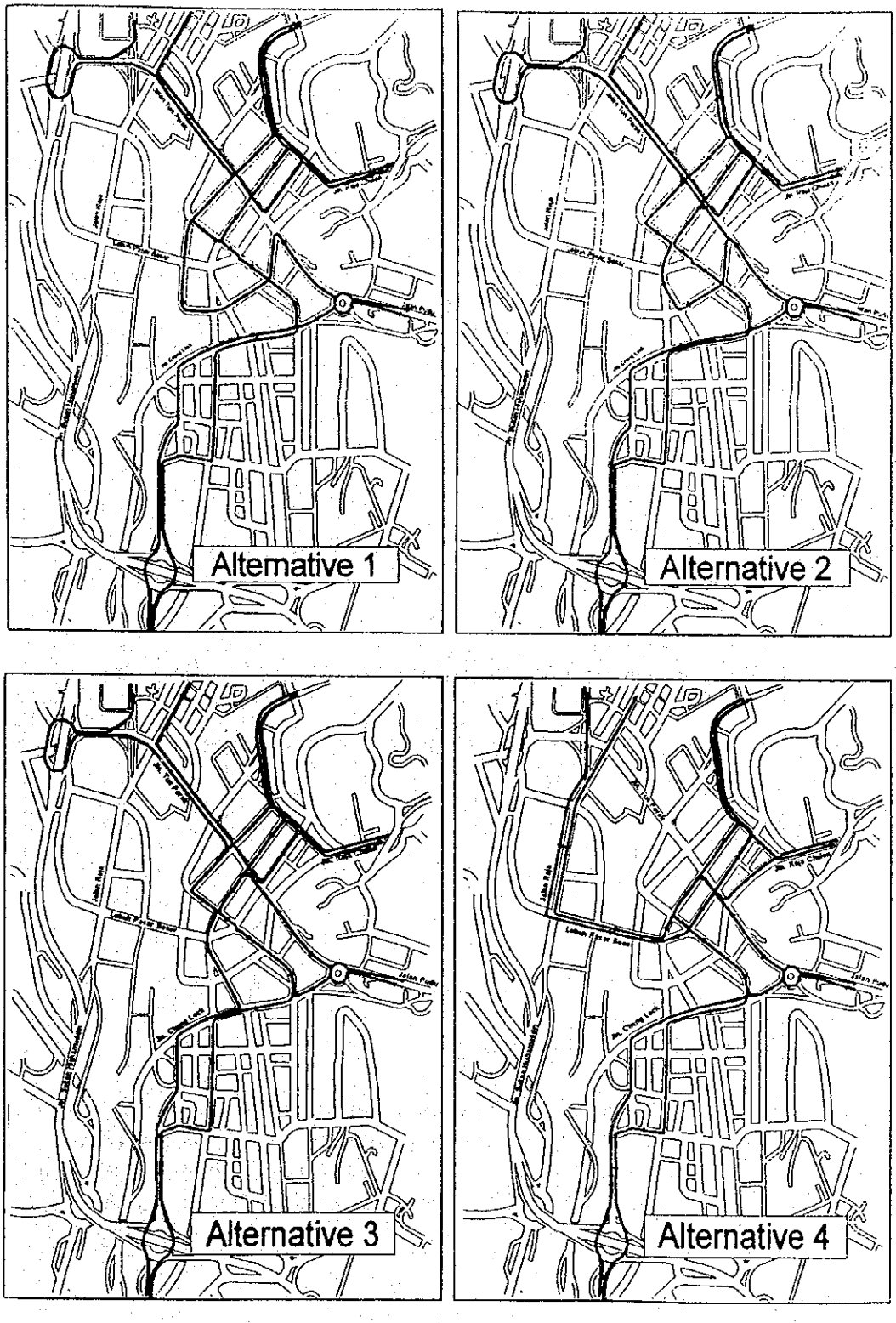


Figure 10.1.13 Bus Re-routing Alternatives

3) Qualitative Assessment for Bus Re-routing Alternatives

Table 10.1.5 shows the qualitative assessment of the strong and weak points of each alternative. From this assessment, it is concluded that Alternative 3, which performed relatively well on all assessment items, is the most desirable alternative. The immediate improvement plan is to propose a packaged plan consisting of a traffic circulation plan including a road facilities plan, and the results of the bus re-routing alternatives.

Table 10.1.5 Qualitative Assessment for Bus Re-routing Alternatives

Current traffic problems	Re-routing alternatives			
	1	2	3	4
1. From view of conflict with private traffic				
a. Conflict with through traffic routes				
- Jln. Pasar Besar route	○	○	○	●
- Jln. Tun HS Lee route	△	●	●	△
b. Conflict with internal traffic				
- Circumferential route	●	△	○	○
- Radial route	△	△	△	●
2. From view of bus traffic operating				
a. Reduction of trips in area by re-routing	○	○	○	○
b. Accessibility to arterial roads				
- Jln. Tun Perak Rd. from/to north & east	○	○	○	○
- Jln. Sultan Hishamuddin Rd. from/to north & south	●	●	●	○
- Jln. Cheng Lock Rd. from/to south	●	●	○	●
c. Influence due to conflict among buses	○	○	○	○
d. Reduction of blocking due to bus merging	○	○	○	●
e. Influence of blocking due to loading/ unloading (on narrow road width of Lbh. Pudu.)	●	●	○	○
f. Convenience of passenger route transfer	△	○	○	○
3. From view of pedestrian				
a. Safety of pedestrian traffic	-	-	-	-
b. Pedestrian-friendly of sidewalk	-	-	-	-

Note: ○ : strong point
△ : better than weak point
● : weak point

4) Notes on Implementation of Bus Re-routing Plan

From the foregoing section, it can be seen that there will be changes in pedestrian and bus passenger movement in the action plan area. Therefore, it is necessary to implement the appropriate pedestrian facilities plan of Alternative 3, which was considered to be the most desirable. The issues on the implementation of pedestrian facilities plan are described below:

a. Bus Stops for Transfer Purpose

Along with the proposed bus re-routing plan in the area, bus stops for transfer purposes will be established along the bus routes. At present, bus passengers

transferring in the north, east, and west directions are seen in the area bordered by Jln. Hang Kasturi, Lebuh Pudu, Jln. Silang, Jln. Yap Ah Loy, and Jln. Pasar Besar. Under the proposed re-routing, the bus stops for transfers must be located along the bus routes, in the vicinity of the present one if possible. These bus stops should be established on roads with the bus priority system, so as to ensure sufficient pedestrian space and a reduction in walking distance. The desired roads for such bus stops are assumed to be in the area surrounded by Jln. Tun H. S. Lee, Lebuh Pudu, and Jln. Silang. The location of the bus stops should be determined based on detailed information from the of bus companies.

b. Relocation of Bus Stops

Under the bus re-routing plan, the pedestrian facilities should be improved, especially between terminus points, to encourage people to walk. Taking walking distance into consideration, bus stops should be installed within 250 metres of the centre area of Jln. Tun H. S. Lee - Lebuh Pudu - Jln. Silang. The location of the bus the stops in the area may be envisioned as follows:

- Routes from north to east: a section of Jln. Tun H. S. Lee - Lbh. Pudu on Jln. Silang
- U-turn routes from north: sections of Jln. Tun Perak - Jln. Silang on Jln. Tun H. S. Lee, Lbh. Ampang - Jln. Tun H. S. Lee on Jln. Silang, and Jln. Silang - Jln. Tun Perak.
- Routes from east to north: sections of Jln. Tun Perak - Jln. Silang on Jln. Tun H. S. Lee, Lbh. Ampang - Jln. Tun H. S. Lee on Jln. Silang, and Jln. Silang - Jln. Tun Perak.
- Routes from north to south: a section of Jln. Tun H. S. Lee - Lbh. Pudu on Jln. Silang
- Routes from south to north: a section of Jln. Lbh. Pudu - Jln. Silang on Jln. Tun HS Lee

c. Relocation of Street Vendors

In order to improve the pedestrians' environment, existing street vendors along the bus routes and the access roads for transfer should be moved to neighbouring open spaces such as pedestrian roads. These street vendors could be re-located in the above-mentioned area bordered by Jln. Tun H. S. Lee, Lebuh Pudu, and Jln. Silang.

(5) Traffic Circulation Plan

1)Basic Strategies for Traffic Circulation plan

In order to address the strategies of ensuring smooth traffic flow, the traffic circulation plan is formulated by introducing a system of separate road functions, traffic restrictions, and results of the bus re-routing plan. The basic strategies for the plan are described below:

- The road network will rely on the existing roads.
- Roads will be given separate functions, and through traffic and buses will be segregated in order to improve the flow of traffic originating and ending in the action plan area.
- In principal, collector roads for access within the area will be regulated by a one-way system in order to increase the traffic capacity.

a. Basic Road Network Pattern

In order to address the segregation strategy of through and internal traffic in the area, the traffic circulation system should be adopted by introducing a traffic control system with separate road functions. This control system will be achieved by the combination of local roads (collectors) with a loop or a cul-de-sac, bus-exclusive roads, and pedestrian roads.

From the standpoint of traffic control, three basic road network patterns can be envisioned as shown in Figure 10.1.14. Pattern 1 (loop pattern) is characterised by the fact that it attempts to eliminate through traffic entering the area. Pattern 2 (grid pattern) is characterised by its emphasis on providing maximum convenience to intra-area vehicular traffic. Pattern 3 (linear pattern) aims at separating intra-area vehicular traffic from pedestrian traffic.

Furthermore, from the standpoint of pedestrian traffic flow, Pattern 1 (loop pattern) and 3 (linear pattern) are suitable for ensuring the safety of pedestrians, unlike Pattern 2 (grid pattern) where the movements of pedestrians are interrupted due to some breakpoints.

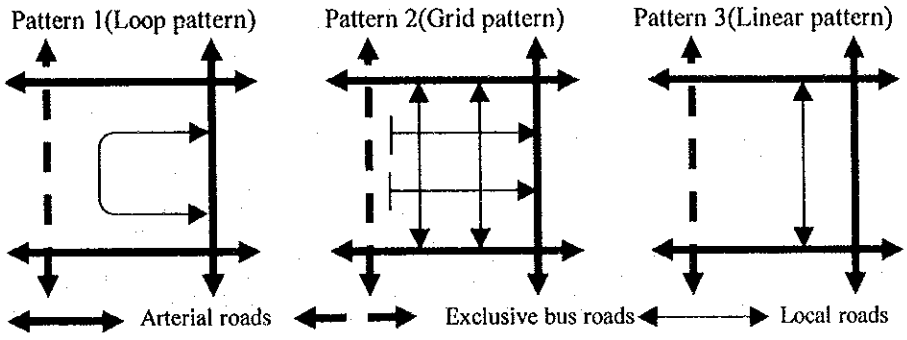


Figure 10.1.14 Basic Patterns of Collector Network

b. Concept of Traffic Circulation System

From the basic road network patterns for the traffic control system discussed above, the most suitable pattern should be applied to the area by taking into account the kind of traffic control and service that the area requires. The concept of traffic circulation system is classified into two types, i.e., full control of through traffic and partial control of through traffic as shown in Figure 10.1.15.

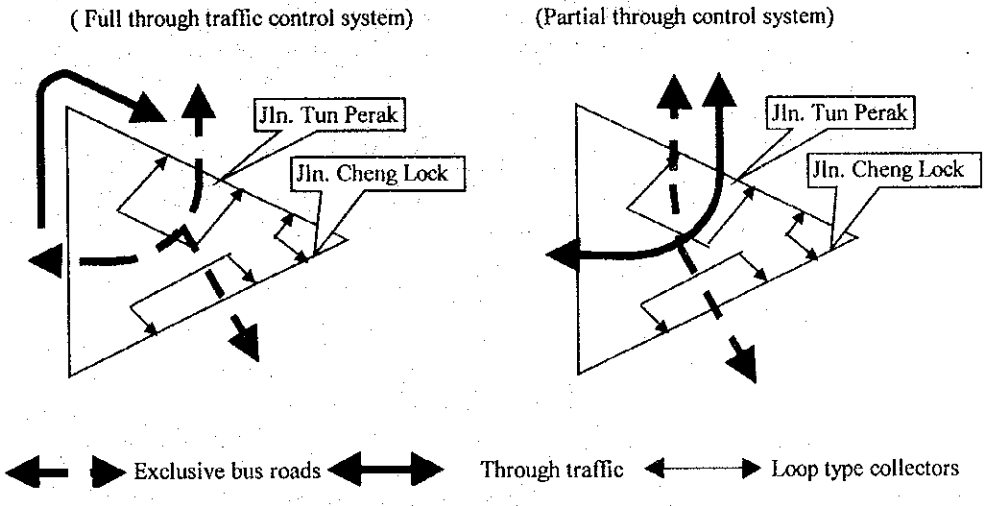


Figure 10.1.15 Concept of Traffic Circulation System

2) Concept of Road Functions

The road functions within the action plan area, where the traffic circulation system is enforced, are listed in Table 10.1.6. In principal, the type of roads by functions are classified into three (3): arterial roads, collectors (collectors for internal traffic,

collectors for through traffic, collectors for bus-exclusive roads, and collectors with bus priority lanes), and pedestrian roads.

a. Arterial Roads

Jln. Tun perak, Jln. Cheng Lock, Jln. Raja and Jln. Sultan Hissamuddin and the arterial system of the action plan area. These arterial roads must have enough capacity to allow concentrated volume of traffic flow to/from the area.

The arterial roads must have enough capacity to allow concentrated volumes of traffic to flow into and out of the action plan area. Jln. Tun Perak, Jln. Cheng Lock, Jln. Raja, and Jln. Sultan Hishamuddin from circumferential roads of the action plan area are arterial roads.

b. Collectors

Essentially, collectors provide access to roadside offices, stores, residences, and so on. At present, existing local collectors such as Lebuh Pasar Besar, Jln. Tun H. S. Lee, and Jln. Hang Lekiu in the action plan area function as semi-arterial roads, serving vehicles travelling within the area surrounded by the arterial roads. These roads play an extremely important role in providing services to intra-CBD traffic, eliminating through traffic, and giving access to pedestrian roads. Therefore, for the action plan, these collectors are classified into four (4) types depending on their functions, such as collectors for internal traffic, collectors for through traffic, bus-exclusive roads, and collectors with bus priority lanes.

Table 10.1.6 Road Functions and Regulation in the Action Plan Area

Type of roads		Function	Regulation
1. Arterial Roads		- Aterial function for external traffic and through traffic.	- Two ways
2. Collectors	a. Internal traffic	- Access service for office, shop and residences.	- One way
	b.Through traffic	- Partial services for through traffic.	- One way
	c. Bus exclusive way (Bus Transit Mall)	- High services for area bus transport. - Pedestrian safety. - Barrier for eliminating through traffic. - Open space for pedestrians/bus passengers space and street furniture (community space).	- One way - Buses only
	d. Bus priority lane	- Bus priority services on major roads.	- One way - Buses only
3. Pedestrian Roads (Pedestrian Mall)		- Pedestrian services on collectors - Barrier for eliminating through traffic - Open space for pedestrians and street furniture(community space)	- Pedestrians only

c. Pedestrian Roads (Pedestrian Malls)

Pedestrian roads are established along segments of collectors by eliminating through traffic. These segments will be turned into community spaces such as a shopping mall, greenery with benches, and a rest area. This concept creates space for the relocation of street vendors. Figure 10.1.17 shows the concept on a cross section of a pedestrian road.

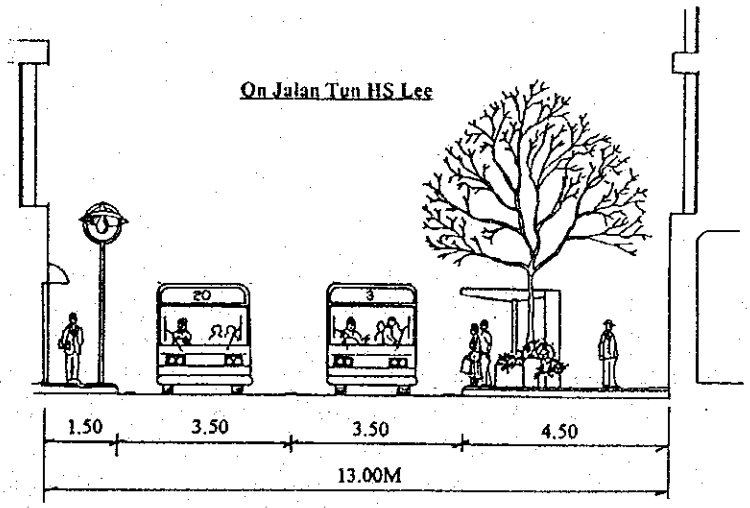


Figure 10.1.16 Concept on a Cross Section of a Bus-Exclusive Road

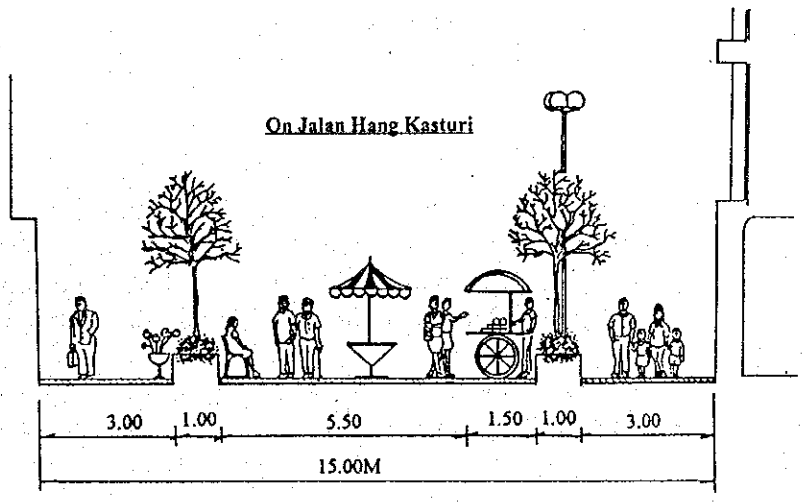


Figure 10.1.17 Concept on a Cross Section of a Pedestrian Road

(6) Formulation of Alternatives for Immediate Action Plan

Based on the foregoing bus re-routing plan and the traffic circulation plan, seven (7) alternatives were determined for the immediate action plan in the Model Area, as shown in Table 10.1.7 and Figure 10.1.18. These alternatives are classified into two (2): a full through traffic control system and a partial through traffic control system. The former involves very strong traffic regulation where the through traffic control is based on the zone system, while the latter is only a partial through traffic control. Furthermore, there are three alternatives for the full through traffic control, i.e., Alternatives 1-1, 1-2, and 1-3. There are four alternatives for the partial through traffic control, i.e., Alternatives 2-1, 2-2, 2-3, and 2-4. The Alternatives are characterised from the following standpoints of traffic control.

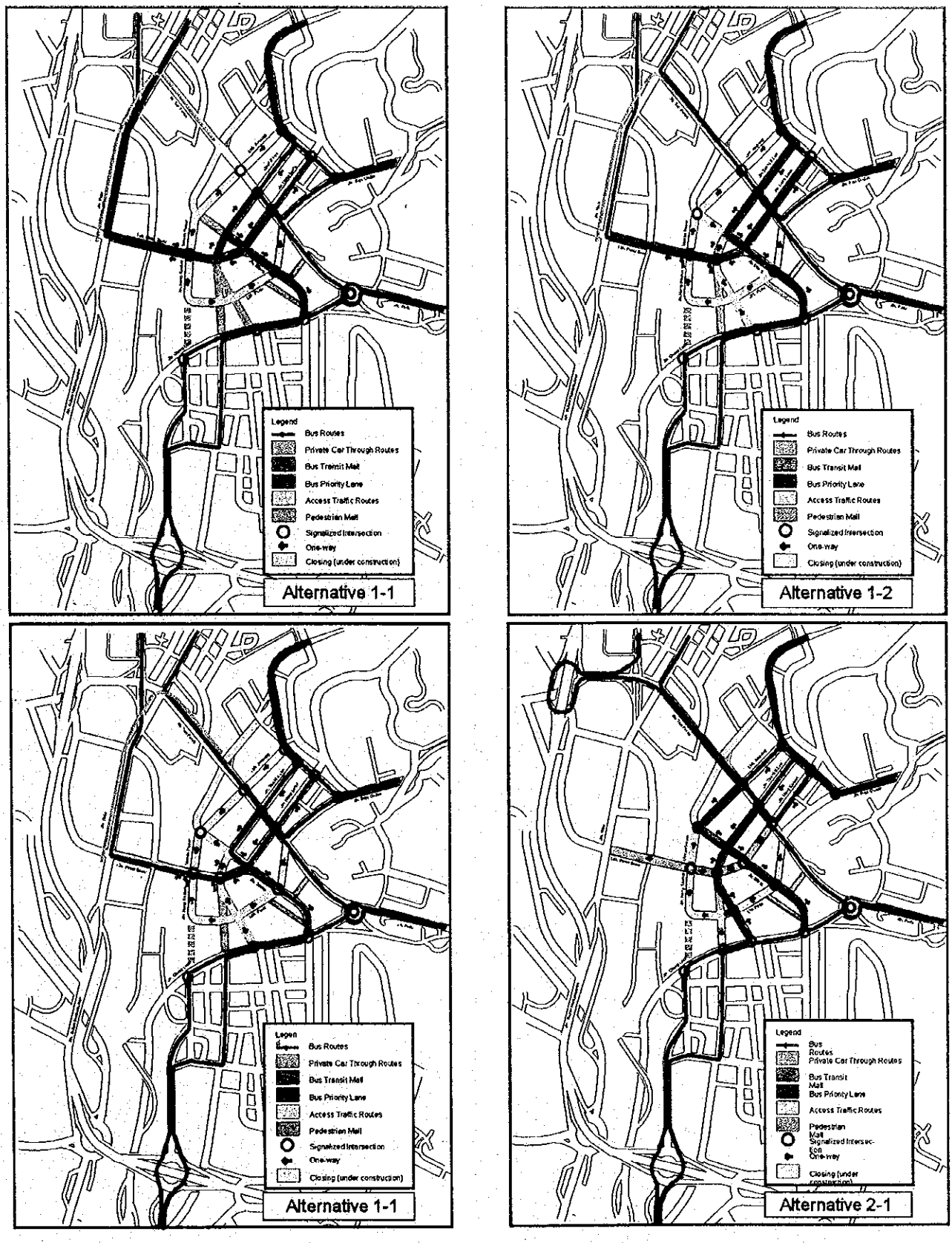
1) Full Through Traffic Control System

a. Alternative 1-1

Alternative 1-1 adopts bus transit malls on the major roads in order to eliminate through traffic entering from the north, south, east, and west. The bus transit malls are established along through roads such as Lebuh Pasar Besar, Jln. Yap Ah Loy, Jln. Hang Lekiu, Jln. Tun H. S. Lee, and Jln. Silang, which serve as barriers to through traffic. The bus transit malls, except for Lebuh Pasar Besar, are one-way roads. The establishment of bus routes is based on the re-routing plan of Alternative 4. Pedestrian roads are established along the segments of collectors that private vehicles will be unable to pass due to the bus transit malls. The affected roads are part of Jln. Silang, southern Jln. Petaling and Jln. Tun H. S. Lee, and Lorong Pudu. Those who want to have internal access to offices, for example, on the collectors will adopt circumferential routes and then connect to Lebuh Pudu, Jln. Hang Kasturi, Medan Pasar, and Lebuh Ampang. A signal light is required in the intersection of Jln. Silang - Lebuh Pudu.

b. Alternative 1-2

Alternative 1-2 is the same as Alternative 1-1 except that most bus transit malls have been changed into bus priority lane roads. Major through traffic entering from gateways of Lebuh Pasar Besar and Jln. Petaling will be eliminated, once partial bus transit malls and traffic regulations on turns are imposed. The bus transit malls are one-way roads along Jln. Yap Ah Loy and part of Jln. Silang. The pedestrian roads on Jln. Petaling and Jln. Silang will be turned into collectors for internal traffic. Left turns from the southern direction at the signalised intersections of Jln. Hang Kasturi and Jln. Tun H. S. Lee on Lebuh Pasar Besar are prohibited.



LEGEND

Figure 10.1.18 (1)

Alternatives 1-1, 1-2, 1-3, and 2-1 of the Immediate Action Plan

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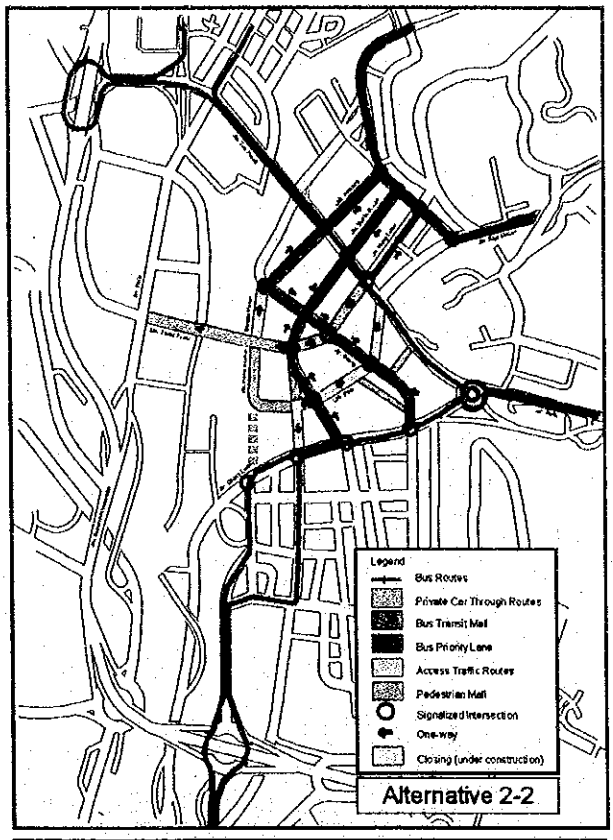

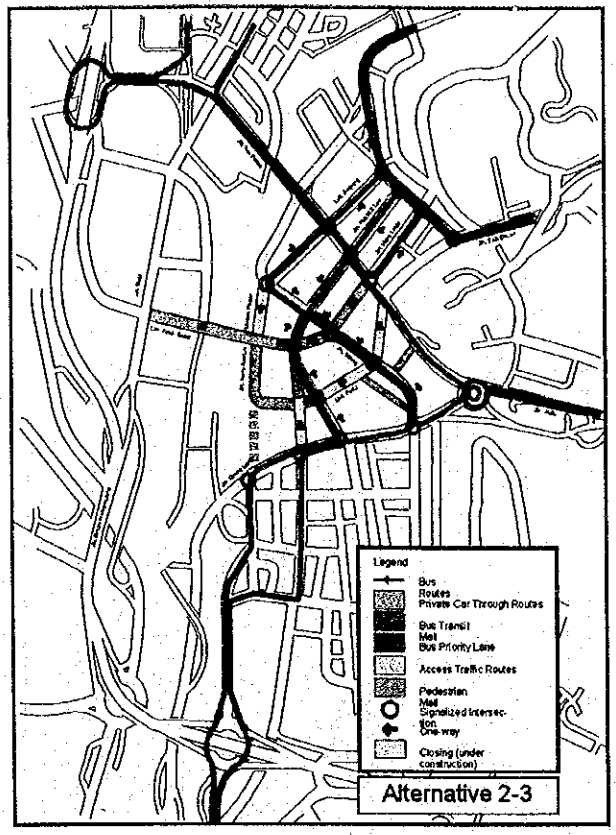

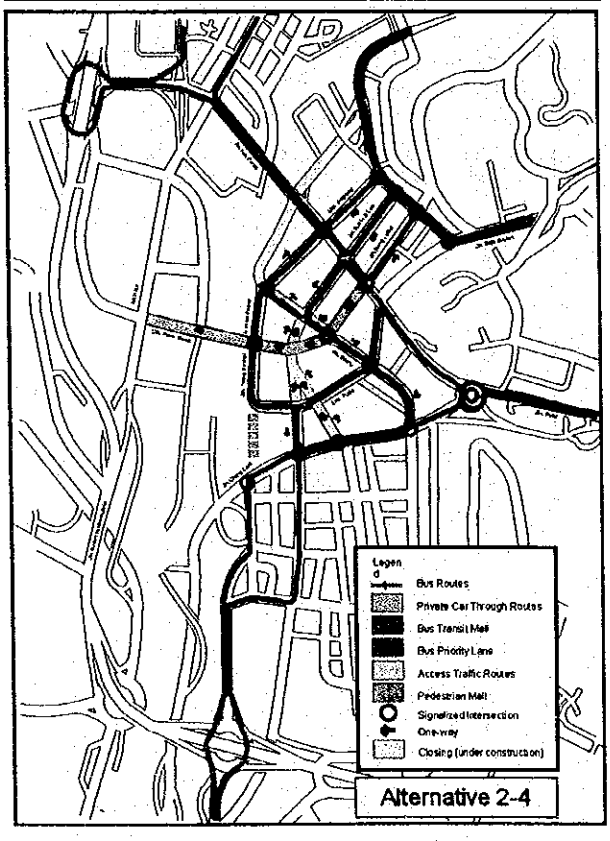

LEGEND

Figure 10.1.18 (2)

Alternatives 2-2, 2-3, and 2-4 of the Immediate Action Plan

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c. Alternative 1-3

Alternative 1-3 is the same as Alternative 1-2 except that all bus priority lane roads have been changed into collectors for internal traffic.

2) Partial Through Traffic Control System

a. Alternative 2-1

Alternative 2-1 shows the function of partial through traffic control, taking into account the impact of heavy through traffic on Lebuh Pasar Besar, Jln. Yap Ah Loy, and Jln. Hang Lekiu. This route is designated as a one-way road for the west-east through traffic, and is segregated from the bus routes so as to improve the current traffic congestion. In order to eliminate through traffic from the gateways of Jln. Cheng Lock and Jln. Tun Perak, this alternative has bus transit malls on the north-south major roads. The bus routes are based on the re-routing plan of Alternative 3, and the bus transit malls are one-way roads. Pedestrian roads are established along the segments of collectors where private vehicles are unable to pass due to the bus transit malls. Pedestrian roads and collectors for internal traffic with access to area are almost the same as Alternative 1-1. A signal light will be installed at the intersection of Jln. Silang - Lebuh Pudu.

b. Alternative 2-2

Alternative 2-2 is the same as Alternative 2-1 except that more than half of the bus transit malls have been changed into bus priority lane roads. The bus transit malls are established on one-way roads along Jln. Tun H. S. Lee, Jln. Petaling, and Jln. Silang, which connect to Jln. Yap Ah Loy. Most collectors for internal traffic have a full loop pattern function, which attempt to eliminate the north-south through traffic from the area. The pedestrian roads on Jln. Hang Kasutri are added in order to make a barrier to eliminate the through traffic from Jln. Cheng Lock.

c. Alternative 2-3

Alternative 2-3 is the same as Alternative 2-2 except that all bus priority lanes have been changed into collectors for internal traffic.

d. Alternative 2-4

Alternative 2-4 has almost the similar structure as the current traffic system except that the vehicular through traffic in the east-west direction has been segregated from the bus routes. The bus routes in the area are based on the re-routing plan of Alternative 1, and there is no priority systems such as bus transit malls, bus priority lanes, and pedestrian malls. However, the north-south through traffic will be eliminated by imposing one-way collectors with a loop pattern.

Table 10.1.7 Alternatives for Immediate Action Plan

Type of strategies	Type of Strategy alternatives						
	Full through traffic control system			Partial through traffic control system			
	1-1	1-2	1-3	2-1	2-2	2-3	2-4
1. Bus priority system							
a. Bus re-routing							
- Re-routing without buses conflict	○	○	○	○	○	○	○
- Re-routing of through type bus routes	○	○	○	○	○	○	○
- Cross linking without terminus points	○	○	○	○	○	○	○
b. Bus transit mall	○	△	△	○	△	△	-
c. Bus priority lane	-	○	-	-	○	-	-
2. Traffic circulation system							
a. Zone system	△	△	△	△	△	△	-
b. One-way	○	○	○	○	○	○	○
c. Through traffic control	○	○	○	△	△	△	△
3. Traffic facilities							
a. Signal control	○	○	○	○	○	○	○
b. Channelization	○	○	○	○	○	○	○
c. Pedestrian mall	○	○	○	○	○	○	-
d. Street vendors relocation	-	○	○	-	○	○	○

Notes: ○ : Full adoption △ : Partial adoption
- : No adoption

10.1.5 Preliminary Assessment of Alternative Plans

The preliminary assessment of the alternative plans comprise of a qualitative appraisal and technical appraisal. These appraisals are described below:

(1) Qualitative Appraisal

The alternatives were evaluated in terms of private vehicle traffic, bus transport, pedestrian traffic, and traffic facilities. Table 10.1.8 shows the qualitative assessment results of each alternative.

1) Qualitative Appraisal from Viewpoint of User Types

Assessment from the viewpoint of different types of users is as follows:

a. From a Viewpoint of Private Vehicles

- Alternatives 1-1 and 2-1 have weaknesses in terms of accessibility of internal traffic, and connection with arterial roads due to the network limitation of collectors. On the other hand, the strong point of Alternative 2-4 is the similarity of its road functions to the current condition, while Alternatives 1-2, 1-3, 2-1, and 2-2 are comparatively good because of the bus priority lanes.

Table 10.1.8 Qualitative Assessment for Strategy Alternatives

Type of strategy	Type of Strategy alternatives						
	Full through traffic control system			Partial through traffic control System			
	1-1	1-2	1-3	2-1	2-2	2-3	2-4
1. From view of private vehicle							
a. Accessibility of internal traffic in the area	C	B	B	C	B	B	A
b. Connection with arterial roads	C	B	B	C	B	B	A
c. Reduction of conflict between internal traffic and buses	A	A	B	A	A	B	C
d. Reduction of conflict between through traffic and buses	A	A	B	A	A	A	C
e. Influence due to making detour of through traffic	C	C	C	B	B	B	A
2. From view of bus transport							
a. Reduction of total trips by re-routing expanding to KL city	A	A	A	A	A	A	A
b. Reduction of total trips by re-routing within action plan area	A	A	A	A	A	A	A
c. Connection with arterial roads	A	A	A	B	B	B	B
d. Reduction of conflict among buses	A	A	A	A	A	A	A
e. Reduction of blocking due to left/right turning of buses	B	B	B	A	A	A	B
f. Influence of blocking due to loading/ unloading (At narrow road width/cross points with through traffic)	A	A	A	A	A	A	C
g. Convenience of route transfer for passenger	A	A	A	A	A	A	B
h. Difficulty of bus operating on re-routing expanding to KL	B	B	B	B	B	B	B
i. Difficulty of bus operating on re-routing within action plan area	B	B	B	A	A	A	A
3. From view of pedestrian traffic							
a. Safety of pedestrian traffic	A	B	B	A	B	B	C
b. Pedestrian-friendly of sidewalk	A	B	C	A	B	B	C
4. From view of traffic facilities							
a. Restricting through traffic	A	A	A	B	B	B	C
b. Increase of private vehicle traffic capacity in area	C	C	C	B	B	B	B
c. Increase of bus traffic capacity in area	A	A	B	A	A	B	C
d. Influence to major intersections on arterial roads	C	C	C	B	B	B	B

Note: A : Excellent
B : Good
C : Fair

- In terms of conflicts among bus routes, Alternatives 1-1, 1-2, 2-1, and 2-2 are strong, whereas Alternative 2-4 is not due to its almost fully separated system between bus routes and private vehicles.

- The strategy of full through traffic control system, as in Alternatives 1-1, 1-2, and 1-3 has a weakness due to its influence on detouring traffic. On the contrary, Alternatives 2-1, 2-2, and 2-3 have scored relatively well in this regard.

b. From a Viewpoint of Bus Transport

- Since the Alternatives were formulated based on the bus priority system, each Alternative scored well on all the assessment items for bus transport.

- Alternatives 2-1, 2-2, and 2-3 are slightly weak in terms of its connection to arterial roads due to the limitation of bus gateways. Alternatives 1-1, 1-2, and 1-3 also show bus-blocking issues due to the bus re-routing.

c. From a Viewpoint of Pedestrian Traffic

- Alternatives 1-1 and 2-1 are strong in terms of safety and pedestrian-friendly sidewalks, whereas Alternative 2-4 is weak in this area.

- Other Alternatives such as 1-2, 2-2, and 2-3 show average scores, indicating relatively good pedestrian traffic.

d. From a Viewpoint of Traffic Facilities

- Regarding the ability to restrict through traffic and to increase bus traffic capacity, Alternatives 1-1, 1-2, and 1-3 are strong. On the other hand, these Alternatives are weak in terms of private vehicle traffic capacity and influence on the major intersections of the arterial roads in the fringe of the area.

- Alternatives 2-1, 2-2, and 2-3 are relatively good as well.

As a result of this assessment, it was found that either Alternative 2-1 or 2-2, which scored relatively well on all the assessment items, is the most desirable alternative.

2) Issues on Implementation of Immediate Action Plan

From the foregoing section, it can be seen that the introduction of the immediate action plan will restrict through traffic in the area and also improve the bus transport and pedestrian environment. However, the action plan will cause a drastic increase in vehicular traffic on the circumferential arterial roads. Therefore, it is necessary to implement appropriate traffic control at the intersections such as channelisation and

signalised control, and to strengthen the enforcement of no-parking regulations on the arterial roads in order to allow the roads to play their proper functions as arterial roads.

Besides, the immediate action plan also calls for the adjustment of current traffic flow in the action plan area by introducing powerful measures. It is crucial to implement the plan in several phases in order to prevent confusion and allow road users to gradually get accustomed to the new system. These issues on the implementation of the immediate action plan are described as below.

a. Traffic Management Plan

i) Improvement of Puduraya Roundabout

The roundabout of Jln. Pudu, Jln. Tun Perak, and Jln. Cheng Lock is observed to be at a near-saturation. Since the rotary system is only useful for moderate traffic volume, the roundabout certainly cannot handle heavy traffic satisfactorily. With the implementation of the action plan, vehicular traffic at the roundabout will certainly increase. It is, therefore, necessary for the roundabout to be converted into a signalised intersection by introducing channelisation improvement. The concept of the improved plan is shown in Figure 10.1.19.

ii) Improvement of Intersections on Jln. Gereja

The intersections of Lebuh Ampang and Jln. Tun H. S. Lee on Jln. Gereja will be improved by introducing new signal lights, in order to control the flow of buses from/to the action plan area based on the proposed bus re-routing plan. Figure 10.1.20 shows the concept of the improvement plan.

In the case of full through traffic control system (Alternatives 1-1, 1-2, and 1-3), these two intersections will be provided with full signal lights, and there will be three (3) signalised intersections controlled by a co-ordination system. Two (2) signal phases are proposed by the co-ordinated control system with a cycle length of approximately 60 seconds.

In the case of partial through traffic control system (Alternatives 2-1, 2-2, 2-3, and 2-4), the southern approach of Lebuh Ampang will be installed with a bus priority lane for right-turning buses toward Jln. Raja Chulan. Two signal phases are proposed with a cycle time length of approximately 60 seconds through co-ordination with the adjacent Jln. Hang Lekiu signalised intersection.

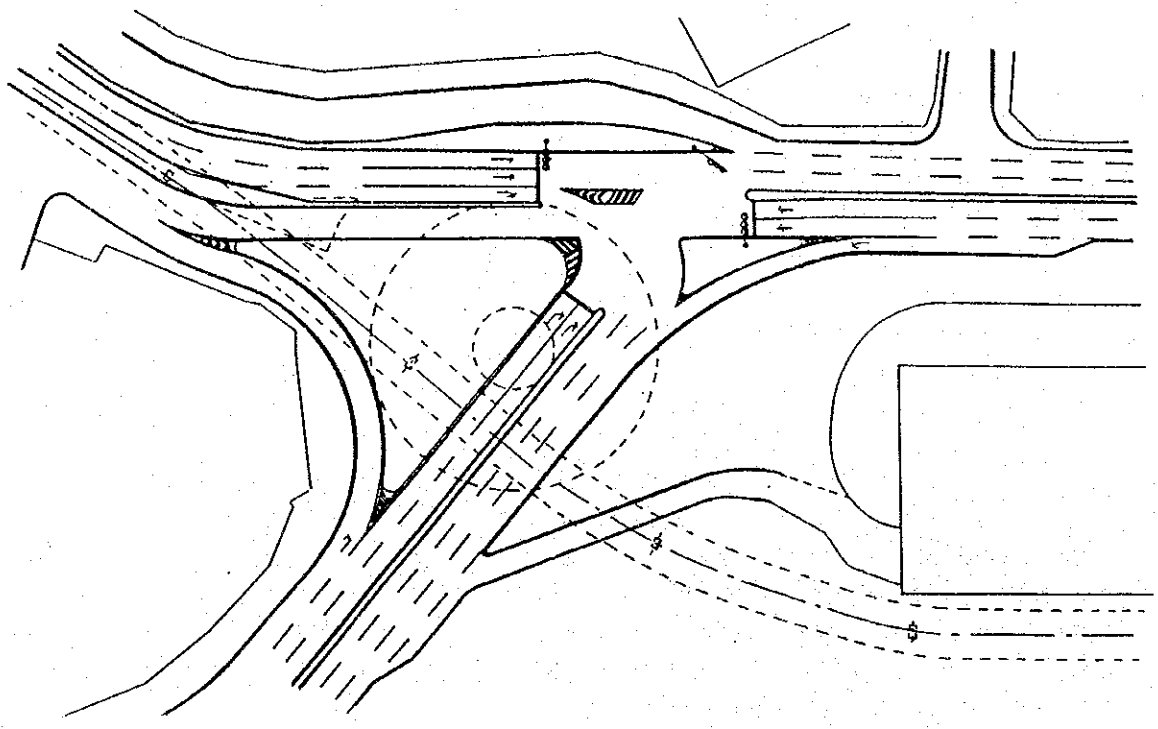


Figure 10.1.19 Concept of Improvement Plan on Puduraya Roundabout

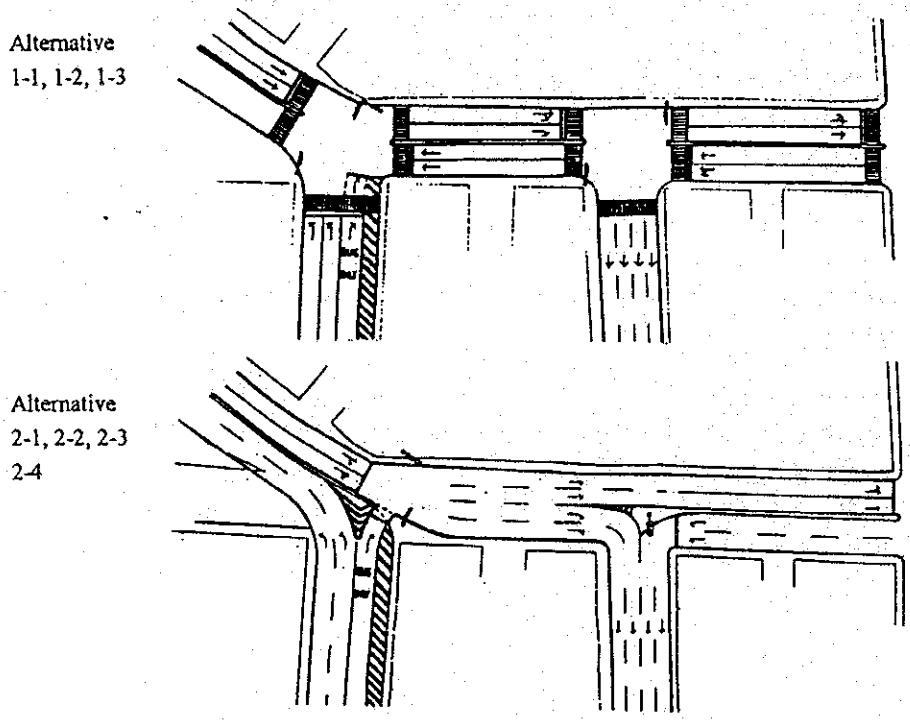


Figure 10.1.20 Concept of Improvement Plan on Jln. Gereja

b. Stages for Implementation of the Immediate Action Plan

The following stages are recommended. Before implementing the plan, it is highly recommended that sufficient public awareness through radio or newspapers be carried out in order to prevent confusion.

- Stage 1: Implementation of traffic management plan by improving intersections such as the Puduraya roundabout, installing new signal lights, etc.

- Stage 2: Implementation of the traffic circulation plan proposed in this study by introducing bus transit malls and bus priority lane roads, and one-way regulation.

- Stage 3: Implementation of the traffic circulation plan proposed in this study by introducing pedestrian roads.

10.1.6 Traffic Flow Analysis by Dynamic Simulation

(1) Program of Dynamic Simulation

The Microscopic Dynamic Traffic Simulation Program is a software application which has been designed for analysis of traffic flow in a road network. This program creates vehicles, each of which follows the vehicle ahead and determines its behaviour based on the surrounding conditions at every time step until it reaches its destination. Each generated vehicle has its own desired speed, vehicular acceleration/deceleration performance, final destination, and route to the destination. Such a variety of vehicles' characteristics create irregular, frictional traffic flows, thus reproducing traffic congestion in the computer.

To be more precise, the Dynamic Simulation Program can reproduce the following phenomena in one way or the other:

-Traffic disorder caused by the co-existence of slower vehicles;

-Traffic flow at signalised intersections;

-Merging and weaving traffic (including at roundabouts); and

-Traffic behaviour depending on the road structure.

The program then produces computed outputs such as the traffic capacity of all or a portion of the network, average speed and stopping delay of vehicles by sections, etc. Therefore, the application of this program turns out to be very effective, especially when several alternative plans of road network are worked out together. Besides, it is necessary to have some kind of quantitative approach for the comparison of the efficiency of each plan.

(2) Distinctive Alternatives for Comparison

As such, this Dynamic Simulation has been applied for the comparison of the alternative immediate action plans in the model area which were discussed in the previous sections. The main objective is to predict how and to what extent private vehicles will be affected by the application of each plan. Some of the proposed plans involve significant changes such as the construction of bus transit malls and/or pedestrian malls, enforcement of new traffic regulations, and so forth, while others do not require drastic change. From the proposed plans, three distinct alternatives listed below have been picked up for comparison.

-The most drastic plan involves the improvement of local bus flow by giving the buses the highest priority in the central area and the exclusion of private vehicle through traffic (Alternative 1-1).

-The medium plan is the one where the local bus flow and the through traffic flow of private vehicles are evenly but separately secured and reinforced in the central area (Alternative 2-2).

-The relatively unchanged plan is the one where only the through traffic flow of private vehicles is reinforced in the central area (Alternative 2-4).

The traffic flow situation in the CBD (which is roughly the area surrounded by Inner Ring Road) during one morning peak hour (7:30 – 8:30 a.m.) has been simulated for comparison by this program. The analysis was conducted by using two kinds of indices: average vehicle speed and total stopping delay.

(3) Analyses

1) Average Vehicle Speed

Average vehicle speed at intersections can be calculated as a division of the section length by the time taken to travel the whole section. The travel time includes the periods when a vehicle stops at a traffic signal or in a congested area. Therefore, it should be noted that the actual running speed may be higher than the average vehicle speed value.

Based on the forecasted results shown in Figure 10.1.21, three alternative plans were compared with the present case and with each other. Below are some of the findings from this comparative analysis.

-In Alternative 1-1, there is a significant increase in average speed on the collector roads, because a much smaller number of private vehicles will come in to the central area. On the other hand, there is a serious decrease in average speed on all the directions of the arterial roads except for the westbound of Jln. Cheng Lock. This may be due to the private through vehicles which must now make a detour to reach

their destinations, thus resulting in more trips on the arterial roads.

-Alternative 2-2 shows relatively well-balanced results in all the road sections. The traffic flow on the collector roads are smoother than in the present case, especially on the private through vehicle roads. As for the arterial roads, although some influence is exerted by private vehicles coming from the south (i.e., Jln. Cheng Lock) resulting in detours, there is no serious problem in most of the traffic.

-In Alternative 2-4, generally there is no significant change in speed values. The increase in speed on the private vehicle through roads is relatively small, because crossing and conflicting traffic flows still remain. The arterial roads have almost the same values as in the present case.

2) Total Stopping Delay

Total stopping delay is the sum of the times when a vehicle is at a full stop. It is sometimes utilised for the calculation of total emission of carbon dioxide or other gases caused by stopping delay.

Table 10.1.9, shows total stopping delays computed on the arterial roads of the five main streets (i.e., Jln. Gereja, Jln. Tun Perak, Jln. Raja, and Jln. Cheng Lock) and other collector roads. Below are some of the findings from this comparative analysis.

In Alternative 1-1, the decrease in stopping delay on the collector roads is very dramatic. On the contrary, the stopping delay on Jln. Tun Perak and Jln. Raja would become almost twice as much as the current level. Since bus transit malls are adopted on the major roads within the Action Plan area, vehcular traffic being to pass the area have to alter their routes to those outside the area in the case of Alternative 1-1.

-Alternative 2-2 has a large improvement effect on the collector roads, leaving minimum negative influence on the arterial roads. Jln. Tun Perak is the only arterial road with an increased delay, but it is on the same level as that of Alternative 1-1.

-In Alternative 2-4, a slight decrease in delay can be observed on the collector roads. This may be due to the improvement of the private through vehicle roads. On the other hand, there is no drastic change in the delay on the arterial roads.

Table 10.1.9 Dynamic Simulation Forecast: Total Stopping Delay

Morning Peak Hour (7:30-8:30 a.m.) [unit: hour]

Streets	Present	Alternative 1-1	Alternative 2-2	Alternative 2-4
Arterial Roads				
Jalan Gereja	1.2	1.6	1.8	1.6
Jalan Tun Perak	2.8	5.9	6.1	2.9
Jalan Raja	2.3	5.9	2.3	2.5
Jalan Cheng Lock	8.6	5.6	5.5	8.1
Total	**14.9**	**19.1**	**15.7**	**15.0**
Collector Roads*				
Total	**23.2**	**2.0**	**11.1**	**19.0**
Grand Total	**38.1**	**21.0**	**26.8**	**34.0**

* Collector roads indicate all the streets in the model area except for the arterial roads.

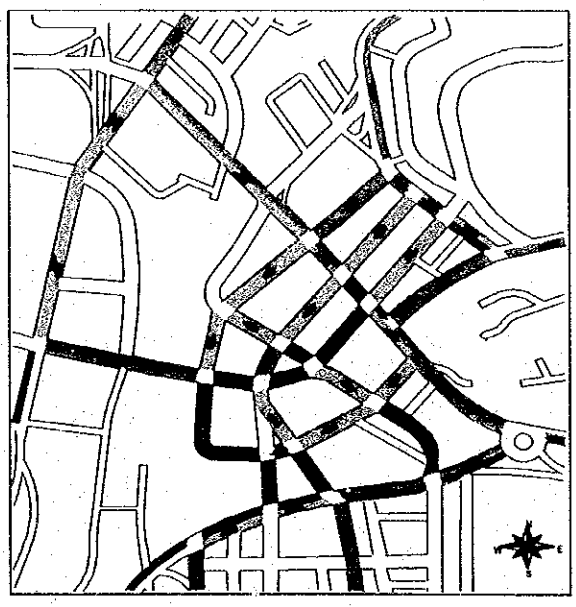
3) Overall Evaluation

The comparative analyses of the two different quantitative indices, i.e., average vehicle speed and total stopping delay, shows that all these three alternative plans will most likely improve the current traffic flow in the model area. Above all, Alternative 1-1 has been proven to have the highest score with respect to total numerical values.

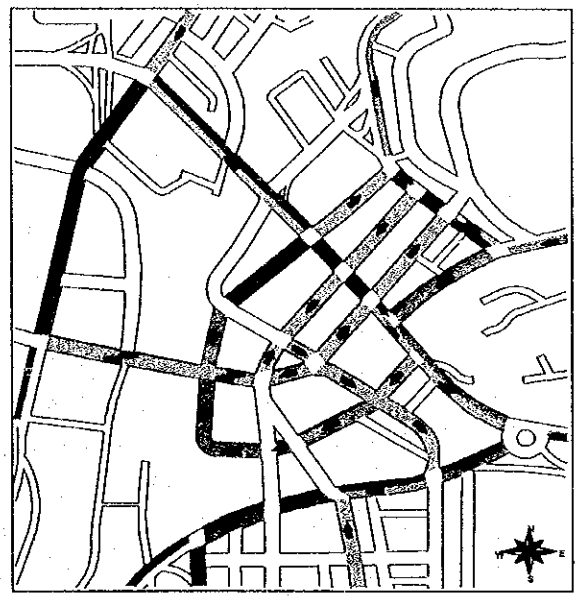
In this alternative, however, the negative influence of the traffic flow on the arterial roads surrounding the model area may be too large, causing an extreme imbalance between the collector roads and the arterial roads. On this account, it may be too risky to adopt this plan.

Based on this criterion, it can be concluded that, among the three distinct alternative plans, Alternative 2-2 has the best-balance in terms of beneficial and negative effects. While this alternative has a high potential to mitigate the current traffic congestion in the central area which has been caused by the chaotic mixture of buses and private through vehicles, it also has the least possible negative influence on the private vehicle users.

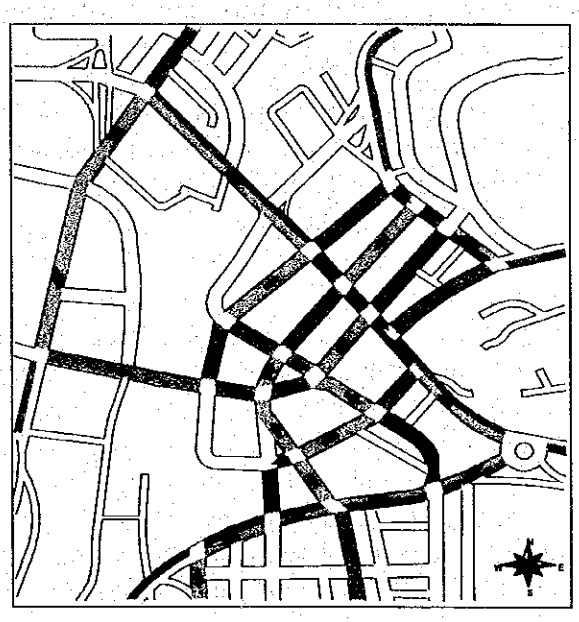
However, it should also be noted that Alternative 2-1, which is the other alternative pertaining to the same category as Alternative 2-2, may have a same effect according to the quantitative assessment by Dynamic Simulation. The only difference may be that Alternative 2-1 involves a larger-scale of construction of bus transit malls construction, thus affecting the private vehicular traffic flow more. This implies that the simulation results for Alternative 2-1 would be somewhat closer to those for Alternative 1-1. In the end, the quantitative analysis showed that out of the three, alternative 2-2 was the most recommendable immediate action plan for the model area.



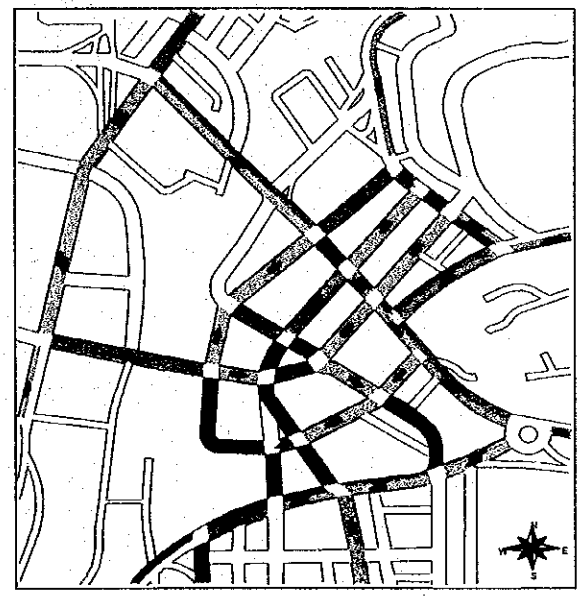
Present



Alternative 1-1



Alernative 2-2



Alernative 2-4

LEGEND

- under 5km/h
- 5-10km/h
- 10-20km/h
- 20-30km/h
- over 30km/h

Figure 10.1.21

Dynamic Simulation Forecast
Average Cehicle Speed

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Environmental Improvement in Kuala Lumpur